In situ conservation of crop wild relatives: introduction and a proposal

Joana Magos Brehm, Nigel Maxted, Zeki Kaya, Shelagh Kell, Ehsan Dulloo, Hannah Fielder, Hannes Gaisberger, Imke Thormann, and colleagues

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Food security / insecurity

‘Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food...’

(World Food Summit FAO 2009)

(The State of Food Insecurity in the World 2013)
Food insecurity — future?

- 7.4 billion (Jul 2016)

9.6 billion by 2050 (UN 2014)

Is human population beyond the earth’s carrying capacity?

To feed the human population in 2050 we will require food supplies to increase by 60% globally, and 100% in developing countries (FAO 2011)
Heavy dependence on narrow diversity of crops puts future food and nutrition security at risk!

- **Globally identified plant species**: 391,000
- **Number of crops used for food by humans throughout history**: 5,538
- **Rice, maize and wheat currently provide 60% of the world’s food energy intake**: 3
- **Number of crops that together with 5 animal species provide 75% of the world’s food today**: 12
Climate change has changed the game

Projected impact of climate change on agricultural yields

Climate change may reduce agricultural production by 2% each decade (IPCC 2014)

* A key culprit in climate change – carbon emissions – can also help agriculture by enhancing photosynthesis in many important (...) crops such as wheat, rice, and soybeans. The science, however, is far from certain on the benefits of carbon fertilisation.*

This map represents the case of beneficial carbon fertilisation processes.

Source: Cline W., 2007, Global Warming and Agriculture.
**Crop Wild Relatives**

- CWR are an important source of trait diversity for crop improvement
- Tried and proven
- Still largely untapped as their importance is not well recognised
- Food and economic security

<table>
<thead>
<tr>
<th>Crop</th>
<th>Traits</th>
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</thead>
<tbody>
<tr>
<td>Wheat (Triticum aestivum)</td>
<td>Drought tolerance</td>
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<tr>
<td>Almond (Prunus dulcis)</td>
<td>Root stock nematodes resistance</td>
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<td>Pigeon pea (Cajanus cajan)</td>
<td>High seed protein</td>
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<tr>
<td>Tomato (Solanum lycopersicum)</td>
<td>Early maturity, fruit size and shape</td>
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<tr>
<td>Aegilops tauschii</td>
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<tr>
<td>P. davidiana</td>
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<td>Lycopersicon pimpinellifolium</td>
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Crop wild relatives

Threatened in the wild - 16% of the species assessed are (near) threatened (intensive farming, tourism, urbanization) (Kell et al. 2012)

Ex situ conservation inadequate

• CWR represent 10.5% of total germplasm accessions
• Globally priority CWR:
  o ≈ ⅓ with no accessions in gene banks
  o ≈ ⅓ with <10 accessions

In situ virtually non-existent

• CWR found in existing PAs but not monitored and actively managed
• Few CWR genetic reserves established but not formally recognized
  (e.g. Ethiopia for wild coffee, Peru for wild potatoes, Armenia for wild wheat, China for wild rice)

Hotspots for ex situ seed collecting

(Castañeda-Álvarez et al. 2016)

Oryza rufifopogon in Gaozhou, Guangdon province, China
(photo: Wei Wei)
**In situ CWR conservation**

To ensure **maximum range of CWR genetic diversity** is represented within the **minimum number of in situ conservation sites/populations**.

Wild wheat in the Erebuni State Reserve (Armenia)  
(photo: René Hauptovogel)
Numerous approaches to *in situ* CWR conservation

- Individual site (population)
- National network
- Regional network
- Global network

**LACK OF GOVERNANCE STRUCTURE!**

**CAN WHC PROVIDE SUCH STRUCTURE?**

**HOLISTIC APPROACH TO CONSERVATION**
EXAMPLE: UK CWR

UK Flora
(4,793 taxa)

CWR checklist
(2,109 taxa, 44% flora)

Prioritization

CWR inventory
(223 taxa)

Site 1: Purbeck
124 (0) taxa

Site 2: Cambridgeshire
17 (104) taxa

Site 3: Ceredigion
11 (99) taxa

(Fielder et al. 2015)
Regional CWR in situ conservation strategies (SADC region)

Development of food and beverage CWR checklist for the SADC region

Prioritization of CWR for conservation action

Identification of priority sites for in situ conservation and ex situ collection (diversity analysis)

Initiation of a Regional Strategy for CWR conservation in the SADC region

Complementarity network:
38 grids (50 x 50 Km) in 11 countries cover 112 priority CWR (3 transboundaries)

Includes existing PA

Important diversity of wild relatives of:
- coffee
- cucurbits (cucumber, gherkin, melon)
- eggplant
- lettuce
- millets
- okra
- pulses (cowpea, pigeon pea, sword bean)
- rice
- sorghum
- watermelon

SADC Crop Wild Relative project
(http://www.cropwildrelatives.org/sadc-cwr-project/)
Global CWR in situ conservation network

Top 50 sites to conserve 1,392 CWR species from 194 gene pools, representing 37 families and 109 genera

(Vincent et al. 2017)

Crop Trust Project - http://www.cwrdiversity.org/checklist/
A PROPOSAL: TO ESTABLISH THE N.I. VAVILOV CWR NETWORK OF *IN SITU* CONSERVATION

The first step: a Turkish network of *in situ* CWR sites!

UNESCO World Heritage Sites?
UNESCO World Heritage Sites — Selection Criteria

“(v) to be an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change”

- Sites where CWR occur associated with particular land-use types (e.g. farmers’ fields)
- Highly diverse areas in terms of CWR in centres of crop domestication where traditional land-use predominates?
- Associate CWR and unique landrace’s management?

“The cultural landscape of Grand Pré bears exceptional testimony to a traditional farming settlement created in the 17th century by the Acadians in a coastal zone with tides that are among the highest in the world. The polderisation used traditional techniques of dykes, aboiteaux and a drainage network, as well as a community-based management system still in use today. The resultant rich alluvial soil enabled continuous and sustainable agricultural development” Criterion (v)…
“(ix) to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals”

• Sites where CWR play an important role in ecological and biological processes?

• Sites where CWR constitute the main plant diversity of important/unique ecosystems and habitats?

“The variations in climate, landforms and altitude have resulted in several overlapping ecosystems and distinct habitats, with short grass plains, highland catchment forests, savanna woodlands, montane long grass plains and high open moorlands. The property is part of the Serengeti ecosystem, one of the last intact ecosystems in the world which harbours large and spectacular animal migrations” Criterion (ix)...
UNESCO World Heritage Sites – Selection Criteria

“(x) to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation”

- CWR are of outstanding value for science (food security)
- Hotspots of important CWR to food security?
- Hotspots of threatened/endemic CWR?

“The Western Ghats contain exceptional levels of plant and animal diversity and endemicity for a continental area. In particular, the level of endemicity for some of the 4-5,000 plant species recorded in the Ghats is very high: of the nearly 650 tree species found in the Western Ghats, 352 (54%) are endemic (...)

The property is also key to the conservation of a number of threatened habitats, such as unique seasonally mass-flowering wildflower meadows, Shola forests and Myristica swamps” Criterion (x)
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Thank you!

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