

B.3. National checklist of landraces

B.3.1. Overview

What is a checklist of landraces?

A LR checklist is a list of names of LR cultivated in a geographically defined area (for instance in a community, a region or a country). This is distinct from an inventory which is a checklist that has associated management, cultivation and use information added.

We need to know what exists, and where, to determine how we can conserve and use it effectively. Checklists of crops and their varieties is therefore a fundamental tool for supporting, facilitating and monitoring the conservation and sustainable use of agro-biodiversity. This was addressed in the Global Strategy for Plant Conservation (GSPC) which recognized a checklist as a means of organizing information in a logical and retrievable way, preventing duplication of effort when planning conservation actions and enabling the planning of the sustainable use of plants—essential resources for food, medicines and ecosystem services.

The knowledge we obtain from checklists of LR will:

- i. help characterising the LR diversity existing in a particular geographic unit hence assist authorities in planning and implementing policies and strategies for conservation and use of agro-biodiversity, which is essential in underpinning national food security,
- ii. help future germplasm surveys and collections to be more efficient,
- iii. allow the accessibility and exchange of information within existing PGR networks, as well as other researchers and research stations.

There are several publications on inter-crop diversity (i.e., diversity between crops) both at a global and national level, but intra-crop diversity (i.e., diversity within crops) information at global and national levels for LR is generally lacking. The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture noted a substantial increase in the number of inventories, both with regards to single crops, groups of species, or within geographically defined areas, but they remain far from systematic. There is to date no standardized methodology for generation of a LR checklist which may explain why the creation of national LR checklists has received little research attention or practical application.



Farmer showing panicle of Nunkho (scented) sorghum landrace in Waruma, Phalombe, Malawi (photo by Edwin A Chiwona).

The preparation of a national checklist of LR can be seen as a five stage process: (i) determine the geographical and crop category scope, (ii) produce a list of included crop diversity (regionally or nationally), (iii) agree on what constitutes a LR, (iv) survey stakeholders to produce the checklist, and (v) Make the checklist available to users. These steps constitute the general methodology, which is illustrated in Figure 12 and described further below.

If there is no prior information of the presence of LR then the compilation of a list of national crop may provide an introduction the national crop networks and experts that can help identify LR diversity. As noted above we have distinguished between a LR checklist (list of LR names from a geographically defined area) and LR inventory (checklist annotated with management, cultivation and use information). This distinction is pragmatic, in that it is often easier to rapidly collate a list of names and then subsequently collate the additional data. However, in practice, when there are little or no pre-existing data on the LR that exist in a certain area, the compilation of the LR checklist and inventory may proceed in parallel. Yet the checklist and inventory are likely to serve different uses, the checklist being used for governmental statistics and the inventory being necessary if the LR are to be fully exploited by the various stakeholder communities. Therefore, both LR checklists and inventories have a distinct role in LR conservation and use.

B.3.2. Methodology for creating a LR checklist

(i) Determine the geographic scope and the target crops.

Discuss and agree the scale of the checklist, whether to cover the whole country or a subunit, whether to cover all crops, a crop category or a subset of priority crops. Two alternative approaches are often referred to in the development of an inventory of LR:

- **A floristic approach** is used to produce inventories of all LR grown in a geographically defined area, either region or country. LR inventories of different regions in a country can eventually be compiled to create a national inventory of LR.
- **A monographic approach** is used to produce an inventory of LR of one or several selected crops. The main difference from the floristic approach is therefore the focused selection of particular target crops for which the inventory is being developed. The selection of crops can also be made at the prioritisation level when a national inventory of LR already exists and the *National management plan for LR conservation* is aimed at solely those crops. LR inventories of specific crops can eventually be compiled to create a national inventory of LR.

Which approach to use, depends on the particular study, as well as financial resources and human capacities. The assumption being the more inclusive the inventory, the greater its use and the likelihood of multiple studies is avoided, therefore a broad geographic and crop scope is recommended where possible.

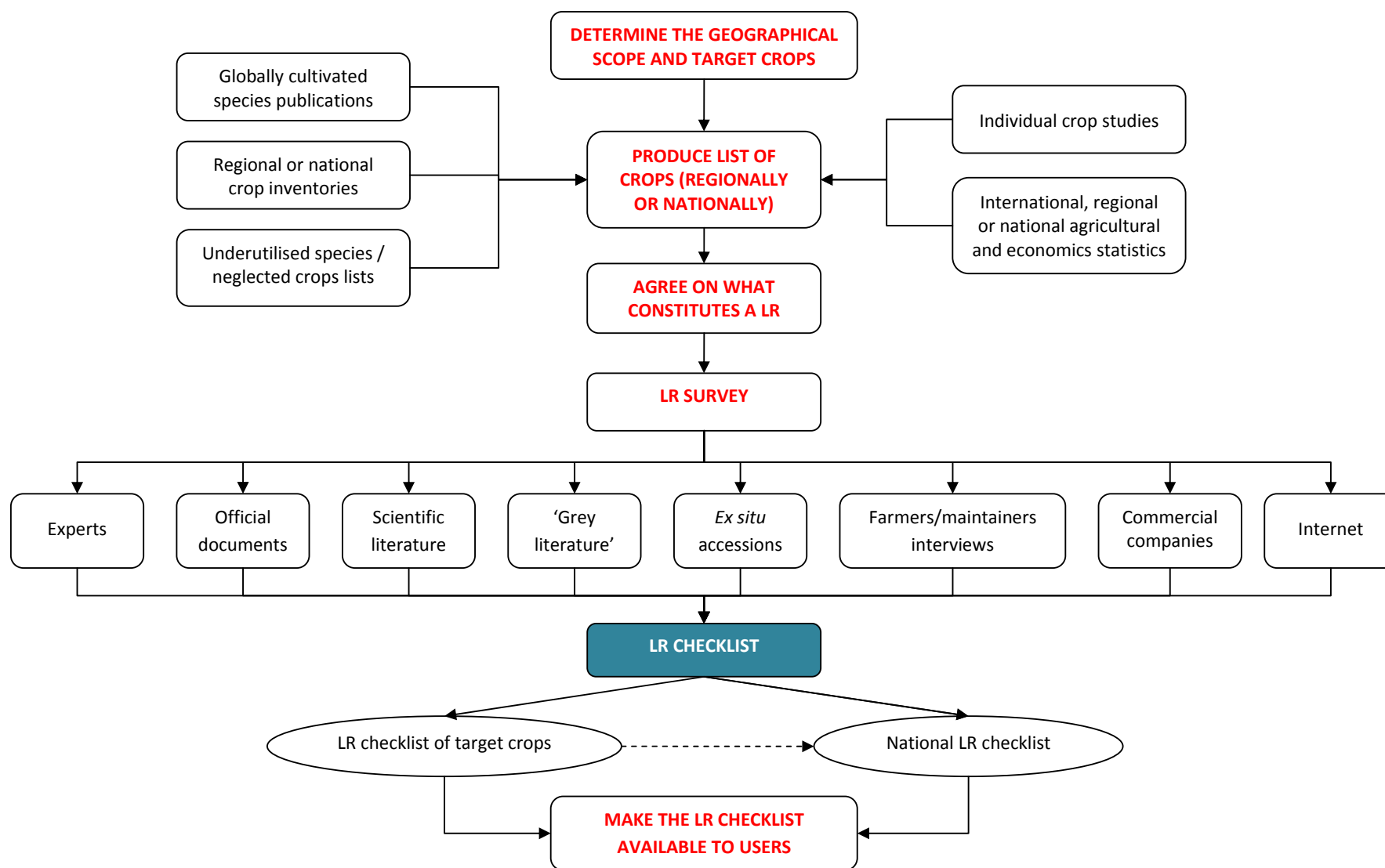


Figure 12. Overview of the creating a national (or regional) checklist of LR

(ii) Produce a list of crop diversity (regionally or nationally).

Several sources have to be consulted when compiling a list of crops grown in a particular country or area. Key sources are:

- Globally cultivated species publications
- Regional or national crop checklists,
- Underutilised species/neglected crops lists,
- Individual crop studies,
- National, regional or international agricultural and economics statistics.

See the 'Additional materials and resources' for concrete references under each key source.

(iii) Agree on what constitutes a LR.

Discuss and agree the working definition to be applied. The definition of what constitutes a LR is of crucial importance and the starting point when formulating a *National management plan for LR conservation*. The definition of LR to be applied is likely to vary between projects, the resources available, the crop scope of the inventory and the reasons of the agency commissioning the inventory. There is unlikely to be one universally accepted definition for all situations and for all crops but common elements of a working definition of a LR are:

- recognisable, distinct crop variety,
- dynamic population character,
- historical origin,
- lacks formal crop improvement,
- genetically diverse,
- locally adapted,
- associated with local cultural, historic or religious values,
- associated with traditional farming systems.

LR can be crops that have developed unique characteristics through repeated farmer selection and never been subjected to formal plant breeding, as well as crops that have been developed in the formal plant breeding sector but which have later been maintained through repeated farmer selection and seed saving schemes. Examples of LR that do not conform to each of the criteria listed above can be found, so a pragmatic decision needs to be taken

by each project on what components will be included in the working definition.

Once the definition is agreed, the researchers need to decide whether to recognise LR based on their nomenclature (two LR with different names are assumed to be distinct) or whether a stricter recognition is required that is based on genetic distinction. The former is likely to be pragmatically adopted but with the rapid development of more efficient molecular techniques this situation is likely to change in forthcoming years. Nevertheless, the use of the nomenclature definition is problematic because it does rely on the assumption that actual genetic distinction is related to LR names, which might not always be the case. The definition of LR used as the basis for the national inventory will ultimately depend on the national scenario and will vary from one country to another.

It should also be recognised that the goal of LR conservation is to maximise the LR diversity conserved and it is by definition assumed that LR will be locally adapted and this adaptation will be reflected in its genetic composition, therefore even if two or more LR have the same name if they are grown in different environments they will be genetically distinct. This of course assumes there is no exchange of seed between local maintainers. However, given this general point it could be argued that should be LR + maintainer not just individual LR, this is a research question that has yet to be investigated and in the interim it seems valid to assume LR with the same name are more closely linked to each other than to other LR, therefore the individual LR, identified on the basis of its name, will remain the focus of the national checklist.



Emmer wheat (*Triticum turgidum* ssp. *dicoccum*) LR grown in Monteleone di Spoleto, Umbria, Italy and Renato Cicchetti, the farmer who ensured the survival of this LR (photo: Renzo Torricelli).

Box 63. Nomenclatural versus genetic definition of landraces in Malawi

To test the hypothesis that there exist correlation between local nomenclature and genetic diversity in sorghum and cowpea, Amplified Fragment Length Polymorphism (AFLP) and morphological characterisation was undertaken on farmer identified LR of sorghum and cowpea found in three regions of Malawi. The sorghum landraces results found significant intra-LR genetically diversity but individual LR were differentiated within the same agroecological region. Also sorghum LR that shared the same local name but were sampled from different environmental conditions were genetically diverse, which implies that when assessing LR genetic diversity it is important to consider differences in the prevailing physical (soils, topography, climate), biological (flora and fauna) and socio-economic (main economic activities, land ownership, gender, age, farming' practices, cultural practices, etc.). Further, higher genetic relatedness exists among sorghum LR within agroecological region of origin than between regions, so sorghum LR cultivated in relative close proximity with different names were genetically more closely related than those with the same name at other locations.

For cowpea LR, the results showed only partial correlation between local nomenclature and genetic diversity, even for those LR with the same name grown relatively closely to each other. Though in the case of cowpea LR are generally recognised by the farmer on the basis of seed size and relative days to maturing and other characteristics may vary. Therefore, the indication is that the local names used by farmers to distinguish LR cannot for cowpea be relied on as a consistent proxy for genetic similarity. In conclusion and in the absence of alternatives we may be forced to use LR names in preparing LR checklists but the relationship between local nomenclature and genetic diversity should be considered when studying diversity.

(iv) Survey and produce a checklist of LR. A number of methods can be used to seek out LR information, including media releases (television, radio, press and internet), advertisements, questionnaires, internet searches, email correspondence, telephone calls and face to face meetings. These are likely to be followed-up by:

- **Farmer interviews.** Farmers themselves can be approached indirectly through advertisements, articles in farmers' magazines and local newspapers, radio or other non-print media, and directly via personal contacts. See examples of LR diversity information collecting form and data descriptors for management data associated with each LR surveyed with the farmers in the 'Additional materials and resources'.
- **Expert consultations.** From gene banks, national testing centres, statutory collections associated with national cultivar listing, research institutes, agricultural extension divisions, farmers' organizations, agricultural statisticians, other professionals and NGOs.
- **Commercial companies** involved in seed production, brewing, milling, distilling, etc.
- **Scientific literature**, including historical literature, research reports, papers and articles.
- **'Grey literature'** associated with gene banks, research institutes, seed companies, NGO newsletters, local farmers' society publications, and farm records.
- **Official documents**, for instance agricultural statistics or national varietal lists.

Also it should not be assumed that all LR must be identified by novel investigations, some may exist and even be conserved but are not recognised as LR. For example, in gene banks LR may not be distinguished from modern varieties or other types of PRGFA. Therefore an initial stage in the survey may be

to clarify whether any LR are present in existing collections but simply not designated as LR accessions.



Scientists facilitating cowpea and sorghum LR discussion with traditional farmers, Mateyu, Chikwawa, Malawi (photo: Edwin A Chiwona).

- (iv) Make the LR checklist available to users. It is essential that the checklist that is created is made available to users, both locally, nationally and globally. To facilitate the widest use, the inventory should ideally be created as a digital database which should be made available to users, ideally via a web-enabled database. Some of the databases currently available are found in the list of 'Additional materials and resources'.

B.3.3. Examples and applied use of LR checklists

There are no examples of complete national checklists of LR. On the other hand, partial national checklists of LR have been prepared in some countries, including Libya^{130,131} and Ethiopia¹³². Most examples are based on organized expeditions to collect specimens and *ex situ* accessions for conservation and evaluation, as well

¹³⁰ Hammer and Perrino (1985)

¹³¹ Hammer *et al.* (1988)

¹³² Yemane *et al.* (2009)

as to collect information on the cultivation method, history and traditional knowledge and use of LR.

Box 64. Checklist of landraces in Ghat Oases (Libya)

A checklist of the cultivated plants occurring in the Ghat oases in Libya was obtained following a collecting mission in 1983. A total of 57 accessions of landraces were collected. The results obtained during this mission, together with observations from all over the Fezzan and from a literature review allowed the preparation of a checklist of the cultivated plants of the Ghat oases.

Source: Hammer and Perrino (1985)

Box 65. Checklist of Sorghum LR in South and Central Tigray region (Ethiopia)

A checklist and inventory of varieties of *Sorghum* LR existing in the South and Central Tigray region in Ethiopia was obtained through a farmer survey. 93 selected farmers were interviewed using a structured questionnaire regarding various socio-economic aspects, as well as landrace characteristics and seed selection and management. A total of 165 collections from 31 locally named *Sorghum* varieties were retrieved and stored at the Mekelle University. The socio-economic factors that affect varietal diversity as well as conservation and incentives strategies were discussed.

Source: Yemane *et al.* (2009)

B.3.4. List of references used to compile the text

CBD (2010) Global Strategy for Plant Conservation 2011-2020. Available from: <http://www.cbd.int/gspc/> [Accessed January 2012].

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FAO (2009) Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture. Food and Agriculture Organization of the United Nations, Rome, Italy.

Hammer K (1990) Botanical checklists prove useful in research programmes on cultivated plants. *Diversity* 6(3-4): 31-34.

Hammer K (1991) Checklists and germplasm collecting. *FAO/IBPGR Plant Genetic Resources Newsletter* 85: 15-17.

- Hammer K and Perrino P (1985) A check-list of the cultivated plants of the Ghat oases. *Kulturpflanze* 33: 269–286.
- Hammer K, Lehman CO and Perrino P (1988) A check-list of the Libyan cultivated plants including an inventory of the germplasm collected in the years 1981, 1982 and 1983. *Kulturpflanze* 36: 475-527.
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- Lughadha EN (2004) Towards a working list of all known plant species. *Philosophical Transactions of the Royal Society of London B*. 359: 681-687.
- Mace GM (2004) The role of taxonomy in species conservation. *Philosophical Transactions of the Royal Society of London B*. 359: 711-719.
- Maxted N and Scholten MA (2007) “Methodologies for the creation of National / European inventories.” *In*: Del Greco A, Negri V and Maxted N. (compilers) *Report of a Task Force on On-farm Conservation and Management, Second Meeting, 19-20 June 2006, Stegelitz, Germany*. Bioversity International, Rome, pp 11-19.
- Maxted N, Veteläinen M and Negri V (2009) “Landrace inventories: needs and methodologies.” *In*: Veteläinen M, Negri V and Maxted N (Eds) *European landraces: on-farm conservation, management and use*. Bioversity Technical Bulletin 15. Bioversity International, Rome, pp. 45-52.
- Negri V, Maxted N and Veteläinen M (2009) “European landrace conservation: an introduction.” *In*: Veteläinen M, Negri V and Maxted N (Eds) *European landraces: on-farm conservation, management and use*. Bioversity Technical Bulletin 15. Bioversity International, Rome, pp. 1-22.
- RBG (Royal Botanic Gardens, Kew) (2004). Stakeholder consultation on Target 1 of the Global Strategy for Plant Conservation and CBD. Draft report. Secretariat of the Convention on Biological Diversity, Montreal, Canada. Available from: <http://www.cbd.int/doc/meetings/pc/tempc-02/other/tempc-02-target-01-en.pdf> [Accessed February 2011].
- Veteläinen M, Negri V and Maxted N (2009b) “A European strategic approach to conserving crop landraces.” *In* Veteläinen M, Negri V and Maxted N (Eds) *European landraces: on-farm conservation, management and use*. Bioversity Technical Bulletin 15. Bioversity International, Rome, pp. 305-325.
- Yemane T, Zeratsion A, Afewerk K and Berhane G (2009) A dynamic Sorghum (*Sorghum bicolor* (L.) Moench) diversity management *in situ* and livelihood resilience in South and Central Tigray Region, Ethiopia. CNCS, Mekelle University 1(2): 67-94. Available from:

<http://www.ajol.info/index.php/mejs/article/viewFile/46049/32457> [Accessed January 2012].

B.3.5. Additional materials and resources

Lists of global or regional crop diversity:

-  Brouk B (1975) Plants consumed by Man. Academic Press, London.
-  EC (European Commission) (2011a) Common catalogue of varieties of vegetable species. 29th complete edition (2011/C 14 A/01). Official Journal of the European Union, 18.01.2011. Available from: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:012A:0001:0026:EN:PDF> [Accessed December 2011].
-  EC (European Commission) (2011b) Common catalogue of varieties of agricultural plant species. Third supplement to the 29th complete edition ((2011/C 328 A/01). Official Journal of the European Union, 11.11.2011. Available from: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:090A:0001:0020:EN:PDF> [Accessed December 2011].
-  Hanelt P and IPK (Institut für Pflanzengenetik und Kulturpflanzenforschung Gatersleben) (eds) (2001) Mansfeld's Encyclopaedia of Agricultural and Horticultural Crops, 6 vols. 1st Engl. Ed. Springer, Berlin, Heidelberg, New York, 3645 pp.
-  Rehm S and Espig GE (1996) Die Kulturpflanze der Tropen und Subtropen. Anbau, wirtschaftliche Bedeutung, Verwertung.
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-  Wiersema JH and Leon D (1999) World Economic Plants. A Standard Reference CRC Press LLC, Washington DC.
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- WW
W Global Horticulture Initiative (2007) PROTABASE - Plant Resources of Tropical Africa: <http://www.globalhort.org/knowledge-base/species/> [Accessed December 2011].
- WW
W IPK (Institut für Pflanzengenetik und Kulturpflanzenforschung

Gatersleben) (2003) *Mansfeld's World Database of Agricultural and Horticultural Crops*. Leibniz Institute of Plant Genetics and Crop Plant Research. Available from: http://mansfeld.ipk-gatersleben.de/pls/htmldb_pgrc/f?p=185:3:1352060495268324 [Accessed February 2005].

WW PROSEA Foundation (n.d.) E-Prosea - Plant Resources of South-East Asia:
W <http://proseanet.org/prosea/eprosea.php> [Accessed January 2012]
(database of both wild and plant resources of South-East Asia)

World Agroforestry Centre (2011a) Agroforestry Database:
WW <http://www.worldagroforestry.org/resources/databases/agroforestry>
W [Accessed December 2011] (data on the management, use and ecology of
tree species from all over the World which can be used in agro-forestry)

World Agroforestry Centre (2011b) Useful Tree Species for Africa:
 http://www.worldagroforestry.org/our_products/databases/useful-tree-species-africa [Accessed December 2011] (this tool enables the selection
of useful tree species for planting anywhere in Africa using Google Earth)

Underutilised crops/neglected species lists:

 Batlle I (2000) Genetic Resources of Minor Fruit and Nut Trees in Europe.
In Maggioni, L. (compiler). Report of a Network Coordinating Group on
Minor Crops (2nd edition). First meeting. 16 June 1999, Turku, Finland.
International Plant Genetic Resources Institute, Rome, Italy.

 Della A (2000) Minor Crops in the Mediterranean Region. In Maggioni L
(compiler) Report of a Network Coordinating Group on Minor Crops (2nd
edition). First meeting. 16 June 1999, Turku, Finland. International Plant
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Crops (2nd edition). First meeting. 16 June 1999, Turku, Finland.
International Plant Genetic Resources Institute, Rome, Italy.

 Pistrick K (2002) Notes on neglected and underutilized crops. Current
taxonomical overview of cultivated plants in the families Umbelliferae and
Labiatae. Genetic Resources and Crop Evolution, 49: 211-225.

- WW Global Facilitation Unit for Underutilized Species (n.d.) GFU Underutilized
W Species GFU Database. Available from: http://www.underutilized-species.org/species/species_mask.asp [Accessed December 2011]
- WW Plants for a Future (1996-2010) Plants for a Future Database. Available
W from: <http://www.pfaf.org/user/plantsearch.aspx> [Accessed December 2011] (a resource centre edible, medicinal and other uses unusual plants)
- WW Freedman B (2011) Famine foods database. Available from:
W http://www.hort.purdue.edu/newcrop/faminefoods/ff_home.html
[Accessed January 2012] (list of plants that are not normally considered as crops but that are consumed in times of famine)

National crop diversity studies:

Albania:

-  Hammer K and Spahillari M (1998) Burimet gjenetike te bimevedhe agrobiodiversiteti. Buletini i Shkencave Bujqesore, 3: 29-36.

Cuba:

- Esquivel M, Castiñeiras L, Knüpfner H and Hammer K (1989) A checklist of the cultivated plants of Cuba. Kulturpflanze, 37: 211-357.
-  Esquivel M, Knüpfner H and Hammer K (1992) "Inventory of the cultivated plants." In Hammer K, Esquivel M and Knüpfner H (eds) (1992-1994). "...y tienen fazones y fabas muy diversos de los nuestros..." - Origin, Evolution and Diversity of Cuban Plant Genetic Resources. 3 vols., 824 pp. IPK, Gatersleben.
- Knüpfner H, Esquivel M and Hammer K (unknown date) A database for the cultivated plants of Cuba. Rev. Jard. Bot. Nac., Habana. In Hammer K (1991). Checklists and germplasm collecting. FAO/IBPGR Plant Genetic Resources Newsletter, 85: 15-17.

Korea:

-  Baik M-C, Hoang H-Dz and Hammer K (1986) A check-list of the Korean cultivated plants. Kulturpflanzen, 34: 69-144.
- Hoang H-Dz, Knüpfner H and Hammer K (1997) Additional notes to the checklist of Korean cultivated plants (5). Consolidated summary and indexes. Genetic Resources and Crop Evolution, 44: 349-391.

Libya:

-  Hammer K and Perrino P (1985) A check-list of the cultivated plants of the Ghat oases. Kulturpflanze, 33: 269-286.
- Hammer K, Lehman CO and Perrino P (1988) A check-list of the Libyan cultivated plants including an inventory of the germplasm collected in the years 1981, 1982 and 1983. Kulturpflanze, 36: 475-527.

Russia:

-  Smekalova T (2009) "Cultivated plants inventory of Russia". In: Veteläinen M, Negri V and Maxted N (eds) European Landraces: On-Farm Conservation, Management and Use. Bioversity Technical Bulletin, No 15. pp.143-154.

South Italy and Sicily:

- Hammer K, Knüpffer H and Perrino P (1990). A checklist of the South Italian cultivated plants. Kulturpflanze, 38: 191-310
-  Hammer K, Knüpffer H, Laghetti G and Perrino P (1992) Seeds from the past. A catalogue of crop germplasm in south Italy and Sicily. Istituto del Germoplasma del Consiglio Nazionale delle Ricerche, Bari. 173 p.

Central and north Italy:

- Hammer K, Knüpffer H, Laghetti G and Perrino P (1999) Seeds from the past. A catalogue of crop germplasm in central and north Italy. Istituto del Germoplasma del Consiglio Nazionale delle Ricerche, Bari. 253 p.

Monographs of crops:

-  *Promoting the Conservation and Use of Underutilized and Neglected Crops* Series which have monographic inventories available from <http://www.bioversityinternational.org/>

International agricultural statistics:

- WW FAOSTAT: <http://faostat.fao.org/> (data on global production and value
W for crops that may be queried at a national level)
- WW EUROSTAT: <http://epp.eurostat.ec.europa.eu> (provides information for
W European Union countries)

Nomenclatural versus genetic definition of landraces:

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-  Majaju C and Chakuya E (2008) Morphological variation of sorghum landrace accessions on-farm in semi-arid areas of Zimbabwe. International Journal of Botany, 4(4): 376-382.