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# **Analysis of the Research and Development Activities Involving Underutilized Plant Species Carried Out by the CGIAR Centres**

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# **Review and Analysis of the Research and Development Activities Involving Underutilized Plant Species Carried Out by the CGIAR Centres**

A report submitted to the Global Facilitation Unit for Underutilized Species (GFU)  
by

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## List of Acronyms

ART – Andean Roots and Tubers  
AVRDC – The World Vegetable Centre  
CGIAR – Consultative Group for International Agricultural Research  
CIAT – The International Centre for Tropical Agriculture  
CIFOR – Center for International Forestry Research  
CIP – International Potato Centre  
CIMMYT – International Maize and Wheat Improvement Center  
CWR – Crop Wild Relatives  
EU – European Union  
GFAR – Global Forum on Agricultural Research  
GFU – Global Facilitation Unit for Underutilized Species  
GIS – Geographic Information Systems  
ICARDA – International Centre for Agricultural Research in Dry Areas  
ICNRM – Integrated Crop and Natural Resources Management  
ICRAF – International Centre for Research in Agroforestry  
ICRISAT – International Crops Research Institute for the Semi-Arid Tropics  
ICUC – International Centre for Underutilised Crops  
IFAD – United Nations International Fund for Agricultural Development  
IFPRI – International Food and Policy Research Institute  
IITA – International Institute of Tropical Agriculture  
IRRI – International Rice Research Institute  
IWMI – International Water Management Institute  
MAPs – Medicinal and Aromatic Plants  
MDGs – Millennium Development Goals  
MTPs – Medium Term Plans  
NARS – National Agricultural Research System  
NBPGR – National Bureau Of Plant Germplasm Research  
NENA – Near East and North Africa  
NGOs – Non-Governmental Organizations  
NUS – Neglected and Underutilized Species  
PGR – Plant Genetic Resources  
SGRP – CG System-wide Genetic Resources Programme  
UNCTAD – United Nations Conference on Trade and Development  
UPGR – Underutilized Plant Genetic Resources  
WARDA – Africa Rice Centre

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## Executive Summary

The Global Facilitation Unit for Underutilized Species (GFU), hosted by Bioversity International, has been commissioned by the System-Wide Genetic Resources Programme (SGRP) with the implementation of Activity 5.3 of the Global Public Goods (GPG) Phase 2 Project. In the context of this activity, a strategic analysis of the current and planned activities of the CG centres (Consultative Group for International Agricultural Research -CGIAR) on underutilized plant species has been carried out. The aim of the analysis reported here is to identify the planned and ongoing projects/activities on underutilized species of the CG centres and the evaluation of their contribution to target System Priorities (namely 1B, 2B, 3A, 4D, 5B, 5D), considering the comparative advantage of the centres in carrying out these activities.

Based on a review of the CG centres' Medium Term Plans (MTPs) and the results of a survey involving more than 30 project managers (with feedback from 71%) conducting activities related to underutilized plant species in the CG centres, it resulted that 9 centres out of the 15 (60% total) work on projects or activities involving underutilized species. One centre (CIMMYT) is in the initial stages of developing some activities and IRRI works on wild relatives of rice. The centres carrying out activities on underutilized species are Bioversity International, CIAT, CIP, ICARDA, ICRISAT, IFPRI, IITA, World Agroforestry Centre (ICRAF) and WARDA. Some centres have extensive projects and activities related to a great number of underutilized species, while others have minor activities embedded in bigger projects. The above centres also report the projects in terms of MTPs. However, details on sub-projects and activities have been obtained through the information provided by the project managers contacted during the survey. The remaining CG centres have not reported any work, for the time being, on projects related to underutilized plant species. IWMI hosts the International Center for Underutilized Crops (ICUC) within a partnership of mutual cooperation.

The survey highlighted the contribution of the projects/activities to the target System Priorities. The survey results show that they address mainly System Priorities 1B (promoting conservation and characterization of underutilized plant genetic resources) and 3A (increasing income from fruit and vegetables). Secondly, System Priorities 5B (making international and domestic markets work for the poor), 2B (improving tolerance to selected abiotic stresses) and 4D (promoting sustainable agro-ecological intensification in low- and high-potential areas) are equally tackled. The least targeted System Priority is 5D (improving research and development options to reduce rural poverty and vulnerability).

The main research gap in achieving the target priorities identified in the survey was the lack of research and, hence, the need for further work on '*Production, consumption and market; Characterization of genetic and agronomic traits and Conservation and sustainable use of underutilized plant species*'. Besides these technical research gaps, there were a number of strategic issues raised by the CG centres during the survey, which can be considered as possible recommendations for strategic areas for CG research in the field of underutilized plant species.

In the survey, a number of comparative advantages for the centres in conducting e activities over other centres and other stakeholders were identified by the project coordinators. One comparative advantage emphasized by some organizations is the centres' location in the centre of origin of the species they are working on, and their close collaboration with the communities managing those species. Other centres have in-house specialists able to manage research on germplasm, breeding, biotechnology, applied economics and policy analysis. Some centres have germplasm collections and facilities to carry out diversity studies. A number of centres have relevant experience and a recognized profile in the field of underutilized plant species, as well as a solid image as honest broker/networking institutes.

A number of underutilized plant species are addressed by projects and activities carried out by CG centres. Nevertheless, there are still many species to be studied and research fields to be tackled. Though some species are addressed by more than one centre, there is no overlap in the research, as the activities address different fields. Most of the species on which the centres are working in their projects are included in the list drafted by GFU. Nevertheless, some project managers would like to see the GFU list modified, including some more identified species and removing some species that they think are not underutilized for a given reason. With regard to this, they made clear indication of the species to be included and removed.

## Introduction

The world is currently overdependent on a few plant species. Diversification of production and consumption habits needs to include a broader range of plant species. More specifically, those currently identified as 'underutilized', can contribute significantly to improved health and nutrition, livelihood, household food security and ecological sustainability. These plant species offer enormous potential in contributing to the achievement of the Millennium Development Goals (MDGs), particularly in combating hidden hunger and offering medicinal- and income-generation options. They are also closely tied to cultural traditions, and therefore, have an important role in supporting social diversity<sup>2</sup>.

The Science Council of the Consultative Group for International Agricultural Research (CGIAR) set a System Priority (namely Priority 1B) to promote the conservation and characterization of underutilized plant genetic resources, in order to increase the income of the poor. The rationale for this priority is that there is a recognized under-appreciation and under-development of promising plant species, the potential of which could be exploited for income, health and nutrition in poor communities. The Science Council adopted the term 'underutilized plant genetic resources (UPGR)' to describe these species. The criteria for identifying UPGR are<sup>3</sup>:

- 1) *the taxon covers several countries and large potential areas,*
- 2) *there are no existing major collections,*
- 3) *exploitation of these species focuses on their use for food, income or health,*
- 4) *there are clear opportunities to enhance health-food linkages,*
- 5) *there is a relatively high level of dependence on the species by the poor or there are clear opportunities for the poor to benefit from the further exploitation of the species,*
- 6) *the species can contribute to the sustainability of production systems (diversification),*
- 7) *it is feasible to establish means for the medium- to long-term conservation of these taxa.*

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<sup>2</sup> Jaenicke, H. and Höschle-Zeledon, I. (eds) 2006. Strategic Framework for Underutilized Plant Species Research and Development, with Special Reference to Asia and the Pacific, and to Sub-Saharan Africa. International Centre for Underutilised Crops, Colombo, Sri Lanka and Global Facilitation Unit for Underutilized Species, Rome, Italy. 33 pp.

<sup>3</sup> Consultative Group on International Agricultural Research (CGIAR) Science Council. December 2005. System Priorities for CGIAR Research 2005-2015

The Global Facilitation Unit for Underutilized Species (GFU) and the International Centre for Underutilised Crops (ICUC) are two organizations that have been active worldwide in promoting, fostering and supporting efforts aimed at realizing the potential of the underutilized plant species to help alleviate poverty and conserve natural resources<sup>4</sup>.

For use in the present report, 'underutilized plant species' are defined by the explanation contained in the discussion paper by H. Jaenicke and I. Hoeschle-Zeledon<sup>5</sup>, 2006. Contributing to the CGIAR System Priorities – The future of underutilized plants research and development: '*Species with under-exploited potential for contributing to food security, health (nutritional/medicinal), income generation, and environmental services*'. These species represent an enormous wealth of agrobiodiversity and have great potential for:

- ✓ contributing to improved incomes, food security and nutrition, and for combating the hidden hunger' caused by micronutrient (vitamin and mineral) deficiencies;
- ✓ are strongly linked to the cultural heritage of their places of origin;
- ✓ are mainly local and traditional crops (with their ecotypes and landraces) or wild species whose distribution, biology, cultivation and uses are poorly documented;
- ✓ tend to be adapted to specific agro-ecological niches and marginal land;
- ✓ have weak or no formal seed supply systems;
- ✓ are recognized to have traditional uses in localized areas, but with considerable potential elsewhere;
- ✓ are collected from the wild or produced in traditional production systems with little or no external inputs;
- ✓ receive little attention from research, extension services, farmers, policy and decision makers, donors, technology providers and consumers;
- ✓ may be highly nutritious and/or have medicinal properties or other multiple uses.

## Background

The GFU has been commissioned by the CG System-wide Genetic Resources Programme (SGRP) to lead Activity 5.3 of the Project "Collective Action for the Rehabilitation of Global Public Goods in the CGIAR Genetic Resources System Phase 2". This activity is entitled 'Optimise the CGIAR's contribution to global efforts on the conservation and sustainable use of underutilized plant genetic resources' and it is coordinated by the GFU's coordinator, I. Hoeschle-Zeledon, in cooperation with H. Jaenicke from ICUC and collaborators from eight CG centres.

The CGIAR recognises the potential contribution that underutilized plant species can make to human health and food security, as reflected in the System Research Priority 1b, specific goals 1, 2 and 3 (see Annex 3); a significant level of research and development activity is already underway. Taking this into account, and building on a study carried out by CIAT and Bioversity International to advise the SGRP on supporting centres in the implementation of System Research Priority 1b, a strategic analysis was carried out with regard to the current level of activity in the CGIAR and elsewhere, and to the CGIAR's niche and comparative advantage. Subsequently, recommendations are made for research to be conducted by the centres in partnership with other practitioners in the area. Emphasis was given to priority-setting mechanisms to ensure that subjects for research meet the real needs of communities, as well as to the selection of subjects for research which can serve as models for a broader application of other underutilized species of the same type (vegetables, fruits,

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<sup>4</sup> Geoffrey Hawtin. July 2007. Underutilized Plant Species Research and Development Activities – Review of issues and options. A report submitted to the chairs of the GFU Steering Committee and the ICUC Scientific Advisory Board

<sup>5</sup> H. Jaenicke and I. Hoeschle-Zeledon, 2006. Contributing to the CGIAR System Priorities – The future of underutilized plants research and development:



grains, etc.). The research recommendations focus on adaptive research of existing methodologies for propagation, cultivation and value addition, and identification of opportunities for the wider cultivation of underutilized species using technologies such as Geographic Information Systems (GIS), wherein the CGIAR has particular expertise.

Within Activity 5.3, a number of sub-activities and tasks were carried out. Sub-activity 5.3.1, entitled ‘Strategic analysis of CGIAR activities on underutilized plant species’, were carried out during the first year of Activity 5.3, January-December 2007. The results demonstrated in this report aim to give an input to one of the milestones of sub-activity 5.3.1, ‘Analysis of the ongoing and/or planned projects on underutilized species regarding their contribution to System Priorities 1B, 2B, 3A, 4D, 5B, 5D’.

During the second year January-December 2008, the sub-activity and tasks named 5.3.2 were carried out: ‘Development of a research agenda for the CGIAR centres on underutilized species’.

## **Aim of the study and methodology**

The aim of the present desk study is to identify the planned and ongoing projects/activities on underutilized species of the CG centres and to evaluate their contribution to relevant System Priorities (namely 1B, 2B, 3A, 4D, 5B, 5D), considering the comparative advantage of the centres in carrying out these activities.

The information and data contained in this report comes from different sources. The steps followed in completing the analysis of the data reported here are the following:

1. Based on a review of the CGIAR centres’ MTPs (2007-2009), a list of ongoing and planned projects dealing with underutilized plant species was drafted. This was made possible through the gathering of information contained on the centres’ websites.
2. With the help of GFU, the contact names of the project coordinators were identified.
3. The coordinators were contacted to confirm that the identified projects actually involved underutilized species and to check whether their centre was also working on other projects/activities involving underutilized species.
4. Once the projects/activities were identified, a survey was conducted inviting the project/activity coordinators, to fill in a questionnaire (see Annex 2), to evaluate the contribution of the projects to relevant System Priorities, identify existing research gaps in achieving these Priorities and to state the comparative advantage of the centre in carrying out their activities over other centres of stakeholders.
5. The respondents were asked to mention the names of the underutilized species they were working on and to comment on the list of the species provided by GFU (see Annex 3).
6. The names of the species were compared with the ones on the GFU list.
7. The results of the data analysis were shared with GFU, ICUC and the CG centres’ coordinators of the identified projects.

The MTPs of all CG centres were revised and 13 centres, whose MTPs mentioned information on underutilized species, were surveyed. Some 31 project coordinators were contacted and invited to fill in the questionnaire (see Annex 2). There was a very high return, with 22 (71%) of those contacted providing a detailed response. In addition to the survey, a number of email exchanges and discussions were held with some of the CG centres’ project coordinators, GFU and ICUC.

### **Target System Priorities**

The System Priorities relevant to this desk study are the following (see Annex 4):

Priority 1B: Promoting conservation and characterization of underutilized plant genetic resources

Priority 2B: Improving tolerance to selected abiotic stresses

Priority 3A: Increasing income from fruit and vegetables

Priority 4D: Promoting sustainable agro-ecological intensification in low- and high-potential areas  
Priority 5B: Making international and domestic markets work for the poor  
Priority 5D: Improving research and development options to reduce rural poverty and vulnerability

## **Results of the study: projects on underutilized plant species at each CG centre**

A review of the MTPs of all 15 CGIAR centres was carried out in order to identify the centres' ongoing and planned projects and activities dealing with underutilized plant species. Project managers were identified and contacted for the purpose of gathering information on the following issues related to their project activities:

1. the project or programme at MTP level, which includes projects/activities on underutilized plant species;
2. the title of the specific projects/activities dealing with underutilized species;
3. a brief description of the specific activities carried out by the project/activity, including the list of species addressed by the activities;
4. major outputs of the projects/activities;
5. a description of how these projects/activities contribute to the System Priorities (1B, 2B, 3A, 4D, 5B, and 5D);
6. identification of any existing research gaps in the project to fully address the above mentioned System Priorities;
7. the comparative advantages of the centre in carrying out the project/activity over other centres and stakeholders.

The results are reported hereafter, listed by centre and project. The results reported and analysis carried out are based on the consultant's revision of the MTPs and the replies received by the project managers of the various centres. Hence, the analysis cannot be considered comprehensive, as some projects or activities could have been omitted from the survey, due to a lack of feedback from 29% of those contacted.

### ***Bioversity International***

*The projects and activities on underutilized plant species*

Bioversity International carries out the following projects related to underutilized plant species, reported at MTP level:

- A. Community Management of Agricultural Biodiversity
- B. Agricultural Biodiversity, Human Health and Welfare
- C. Conservation and Management of Agricultural Biodiversity
- D. Facilitating Use of Genetic Resources
- E. Mobilizing International Partnerships to Use and Conserve Agricultural Biodiversity
- F. Raising Awareness to Create Support for Agricultural Biodiversity

In addition to the reported projects, Bioversity carries out a list of activities and tasks related to underutilized plant species, for instance training courses, etc. Bioversity is involved in activities related to underutilized species in everyday work, with a focus on institutions as well as programs. The list of species reported here may not reflect full coverage, as Bioversity works by groups of species and through pilot species/case studies.

A. The project on 'Community Management of Agricultural Biodiversity' covers the following projects:

- ✓ Adaptive Management of Seed Systems and Gene Flow (Mexico, Cuba and Peru)

- ✓ Programme for Empowering Sahelian Farmers to Leverage Their Crop Diversity Assets for Enhanced Livelihood Strategies
- ✓ *In-situ* Conservation of Agricultural Biodiversity (Horticultural Crops and Wild Fruit Species) in Central Asia Phase II - Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan. (Sub-Programme Biodiversity -13: Agriculture)
- ✓ Western Terai Landscape Complex Project (WTLCP)(Nepal) implemented by NGO partner
- ✓ Home garden project in Nepal implemented by NGO partner
- ✓ Conservation and Sustainable Use of Cultivated and Wild Tropical Fruit Diversity: Promoting Sustainable Livelihoods, Food Security and Ecosystem Services (India, Indonesia, Malaysia, Thailand)

*List of species addressed by the activities*

English name	Scientific name	Activities
bambara groundnut	<i>Vigna subterranea</i>	1. Diversity assessment for useful and economic traits
cowpea	<i>Vigna unguiculata</i>	
sesame	<i>Sesamum indicum</i>	
tiger nut	<i>Cyperus esculentus</i>	
leafy vegetables	--	
okra	<i>Abelmoschus esculentus</i>	
cassia tora	<i>Cassia tora</i>	
alycha	<i>Prunus cerasifera</i>	
sea buckthorn	<i>Hippophae rhamnoides</i>	
pistachio	<i>Pistacia vera</i>	
pomegranate	<i>Punica granatum</i>	
fig	<i>Ficus carica</i>	
almond	<i>Prunus dulcis</i>	2. Improving access of germplasm and knowledge
sesame	<i>Sesamum indicum</i>	
tiger nut	<i>Cyperus esculentus</i>	
leafy vegetables	--	
cassia tora	<i>Senna tora</i>	
taro	<i>Colocasia esculenta</i>	
rice bean	<i>Vigna umbellata</i>	3. Value addition and market links
mango	<i>Mangifera indica</i>	
mangosteen	<i>Garcinia mangostana</i>	
rambutan	<i>Nephelium lappaceum</i>	4. Community-based crop improvement
taro	<i>Colocasia esculenta</i>	
leafy vegetables	--	
gourds	<i>Benincasa hispida</i>	
pigeonpea	<i>Cajanus cajan</i>	

The major outputs of the activities are: i) the development and promotion of practices that support the maintenance, dissemination and use of community knowledge and skills on agrobiodiversity in production systems; ii) understanding and supporting mechanisms and social institutions that maintain and enhance agrobiodiversity for more productive, resilient, and sustainable production systems.

B. The project 'Agricultural Biodiversity, Human Health and Welfare' covers the following projects/activities:

1. 'Development of international cross-cutting initiative on agricultural biodiversity and nutrition', to sensitize policy makers and decision makers and promote linkages among various sectors
2. 'Workshop in Burkina Faso on Agriculture and Health', to bridge the gap between the two sectors
3. 'Global ICUC-GFU-Biodiversity strategy on underutilized /neglected crops', to develop strategic framework in guiding the work on underutilized plant species

4. ‘SGRP/GPG2 NUS Project’, to assess the status of conservation/needs of NUS (neglected and underutilized species) in CGIAR gene banks
5. ‘Assess food diets (and indirectly nutritional status) and their healthful components in selected countries/ areas’, to develop food diet surveys (Malawi, Mozambique, Peru, Bolivia, India)
6. ‘Study on current status of conservation and use of quinoa in Uyuni, Bolivia’, for policy recommendations in enhancing use of target crop
7. ‘Nutritional characterization of VIR hort. spp. gene bank material’, to enhance the use of conserved NUS (forest berries) genetic resources in Vavilov’s gene bank
8. ‘Forest diversity and health compendium of nutrition and healthy function of forestry products’, to provide documentation on nutritional contribution of these products
9. ‘Training of West African scientists in nutrition analysis and food composition research to better capture data and information on local foods (leafy vegetables, NUS)’, to enhance human capacity
10. ‘Project IFAD-NUS II’, value-adding technologies for millet and Andean grains validated and disseminated to communities to enhance production/value adding; training activities on marketing in Yemen, India, Bolivia and Peru; contributing to improvement of regulatory market frameworks; work on ecotourism to promote innovative ways to enhance NUS and related income generations. The project also includes the scaling up of IFAD-NUS Phase I, on work on nutritious millets in India through IFAD loans (*Setaria italica*, *Panicum sumatrense*, *Eleusine coracana*)’ to improve income generation, nutrition, empowerment of rural poor, conservation, capacity building
11. ‘Organization of a training course in Wageningen on marketing NUS’, to enhance capacity building
12. ‘Organization of a training course on value addition, marketing minor millets/NUS in India’, to enhance capacity building
13. ‘Training of facilitators at The World Vegetable Centre (AVRDC) in integrated agricultural research for vegetable/NUS production, utilization and marketing, environmental protection, accountability, gender and participatory approaches’ (capacity building)
14. ‘Analyses of market and value chain of hulled wheat in Turkey and Italy’
15. ‘Study on commercialization and processing of cherimoya in Ecuador, Peru and Bolivia’, to enhance commercialization
16. ‘Provide scientific assistance to the United Nations Conference on Trade and Development (UNCTAD) for the elaboration of safety dossiers of foods subject to EU novel food regulations’, to contribute to improving regulatory market frameworks
17. ‘Use practices for African leafy vegetables/NUS documented and value of food traditions identified, recorded and publicized’, to document knowledge, raise awareness, promote greater use of target species
18. ‘Celebrations of the World Food Day 2007’, to raise public awareness about NUS in various events and countries

#### *List of species addressed by the activities*

Most of the activities deal with many neglected and underutilized species (NUS) chosen case by case. In particular, some activities work on the following species:

English name	Scientific name
foxtail millet, italian millet	<i>Setaria italica</i>
little millet	<i>Panicum sumatrense</i>
finger millet	<i>Eleusine coracana</i>
quinoa	<i>Chenopodium quinoa</i>
cañihua	<i>Chenopodium pallidicaule</i>
amaranth	<i>Amaranthus caudatus</i>
emmer	<i>Triticum dicoccon</i>
cherimoya	<i>Annona cherimola</i>

leafy vegetables	
forest berries	
MAPs	

C. The project 'Conservation and Management of Agricultural Biodiversity' includes the project '*In situ* Conservation of Crop Wild Relatives (CWR) through Enhanced Information Management and Field Application'. This project aims at increasing the knowledge of the conservation status of crop wild relatives in 5 countries by linking global informational systems to national ones, and using the information to execute low-cost *in-situ* activities. The project develops a procedure to analyse and identify needed conservation actions for crop wild relatives in protected areas. It also strengthens links between conservation and development sectors in the countries. The major outputs of the project are: i) developing an internationally accessible information system; ii) developing the National Information System on CWR in the 5 countries of the project; iii) enhancing capacity within the countries to apply information-management technologies in planning *in-situ* conservation of CWR and iv) increasing knowledge and public awareness of value of CWR.

*List of species addressed by the activities*

The project covers a long list of wild crop relatives for each country.

D. The project 'Facilitating use of genetic resources' covers the project entitled 'Promotion of sustainable cherimoya production systems in Latin America through the characterisation, conservation and use of local germplasm diversity' for its conservation both *ex situ* and *in situ*, diversity studies (at morphological, molecular and spatial level), and improved use (good agricultural practices, commercialization).

A series of activities are carried out under the 'Facilitating use of genetic resources' project:

- ✓ characterization of water-use efficiency in almond studies to better understand water-use and root-morphology characteristics with regard to almond;
- ✓ variety Fig (*Ficus Carica*) catalogue for documentation;
- ✓ development of microstallites (SRRs) for *Capsicum* spp., amaranthus (*Amaranthus Hypochondriacus*), tartary buckwheat (*Fagopyrum tataricum*), *Citrus* spp., ginger (*Zingiber officinale*), ginseng (*Panax ginseng*), mung bean (*Vigna radiata*), *Perilla frutescens* and sesame (*Sesamum indicum*) to make SSR markers for underutilized species available;
- ✓ molecular characterization of ginger (*Zingiber officinale*), Job's tears (*Coix lacryma-jobi*) and *Perilla frutescens* for a better understanding of the diversity of several underutilized species;
- ✓ definition of core collections of tartary buckwheat (*Fagopyrum tataricum*), finger millet (*Eleusine coracana*), foxtail millet (*Setaria italica*), proso millet (*Panicum miliaceum*), kodo millet (*Paspalum scrobiculatum*), little millet (*Panicum sumatrense*) and barnyard millet (*Echinochloa frumentacea*) to enhance the conservation of underutilized species through identification of core collections;
- ✓ compilation of a series of descriptors on Cherimoya, *Durio zibethinus*, *Lathyrus*, *Oxalis* and *Ullucus*.

*List of species addressed by the activities*

English name	Scientific name
cherimoya	<i>Annona cherimola</i>
almond	<i>Prunus dulcis</i>
fig	<i>Ficus carica</i>
pepper/chillies	<i>Capsicum</i> spp.
tartary buckwheat	<i>Fagopyrum tataricum</i>
ginger	<i>Zingiber officinale</i>
ginseng	<i>Panax ginseng</i>
citrus	<i>Citrus</i> spp.
job's tears	<i>Coix lacryma-jobi</i>
finger millet	<i>Eleusine coracana</i>
foxtail millet	<i>Setaria italica</i>
proso millet	<i>Panicum miliaceum</i>
kodo millet	<i>Paspalum scrobiculatum</i>
little millet	<i>Panicum sumatrense</i>
barnyard millet	<i>Echinochloa frumentacea</i>
perilla	<i>Perilla frutescens</i>
sesame	<i>Sesamum indicum</i>
mung bean	<i>Vigna radiata</i>
amaranth	<i>Amaranthus hypochondriacus</i>
durian	<i>Durio zibethinus</i>
lathyrus	<i>Lathyrus</i>
oca	<i>Oxalis tuberosa</i>
ulluco	<i>Ullucus tuberosus</i>

In the near future, there will probably be a number of CG mandate crops (*Pennisetum*, *Solanum*, or *Xanthosoma*), for which the programme should provide support at MTP level.

E. The project 'Mobilizing International Partnerships to Use and Conserve Agricultural Biodiversity' covers the project entitled 'Global Facilitation Unit for Underutilized Species (GFU)', which handles the activities of i) analysing policies and formulation of policy recommendations to provide policy-makers with constructive recommendations for creating legal and policy environments in which underutilized species can be better utilized for the benefit of the poor; ii) providing information related to underutilized species, including projects, experts, institutions, species, funding opportunities, training and other events; iii) organising events on underutilized species to enhance and ease communication and knowledge exchange among stakeholders; iv) raising awareness at different levels and for different target groups on the importance of underutilized species for livelihood improvement. The major outputs of the projects are: web portal, policy recommendations, public awareness materials, international events, case studies on different topics (policies, marketing, best practices), strategies for R&D of underutilized species, guidelines on best practices, value chain development, and underutilized species project design and implementation. GFU does not work on specific species, but on cross-cutting issues relevant for all species and most stakeholders.

F. The project 'Raising Awareness to Create Support for Agricultural Biodiversity' covers activities such as the production of awareness material (i.e. brochures and documentaries on various NUS). The main output of the project is the awareness raised on the traditional, cultural, historical and nutritional values of NUS, resulting in a better and greater use of these species.

*Contribution to the System Priorities and identification of existing research gaps*

The following System Priorities have been tackled by the projects.

The project on 'Community Management of Agricultural Biodiversity' tackles all the target System Priorities in the following way:

1B - Identification, characterization and selection of farmer-preferred traits of underutilized and neglected crops that are used as staple crops; e.g. finger millet, taro, beans, etc.

2B - Identification of useful traits adapted to stress tolerance in number of crops/varieties

3A - Selection of productive temperate and tropical fruit tree species/varieties for improving access to germplasm and associated knowledge  
4D - Identification of local crop diversity that is drought-tolerant  
5B - Research on value chain of tropical fruits and link to markets for income generation of poor farmers  
5D - Empowering community in accessing social, human and natural capitals in order to overcome poverty traps.

The projects/activities reported under 'Agricultural Biodiversity, Human Health and Welfare' address the following target System Priorities:

1B: addressed by activities 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 18

2B: addressed by activities 1, 3, 4

3A: addressed by activities 1, 3, 4, 2, 5, 10, 11, 12, 13

4D: addressed by activities 1, 3, 4

5B: addressed by activities 1, 3, 4, 5, 6, 10, 11, 12, 13, 14, 15, 16, 17

5D: addressed by activities 1, 3, 4

The project under 'Conservation and Management of Agricultural Biodiversity' addresses System Priority 1B as many CWR form part of the genepool of the underutilized species which are important to local communities in participating countries. The project aims at developing an effective and efficient strategy for their conservation *in situ*, and also raising the awareness of breeders so that the genetic resources can be characterized and used in breeding programmes.

The projects/activities falling under 'Facilitating use of genetic resources' tackle the target System Priorities in the following way:

1B – conservation, characterization and enhanced use of cherimoya diversity, better understanding of diversity, optimization of *ex-situ* conservation based on core collections

2B – better understanding of water-use efficiency based on characterization of root morphology

3A – market studies on underutilized fruits species, better cultivation practices

5B – improving cherimoya commercialization options

5D – reducing rural poverty

The project under 'Mobilizing International Partnerships to Use and Conserve Agricultural Biodiversity' addresses all the target System Priorities:

1B – promoting conservation and wider use of underutilized species, by creating the awareness towards this aim and working for improved legal and policy environment to facilitate the work of the stakeholders in these areas;

2B – facilitating work on the ability of underutilized species to deal with abiotic stresses (e.g. climate change);

3A – promoting the value chain concepts to allow producers and small-scale processors to benefit from the commercialization of these crops; collaborating with training institutions to provide the necessary skills for marketing underutilized species;

4D – working for the conservation, promotion and use of underutilized species as a mean to diversify agricultural production, in particular in marginal conditions rendering low-potential areas economically interesting;

5B – collaborating with partners to work towards an amendment of the EU Novel Food Regulation and, hence, towards better access to underutilized species in EU markets;

5D – promoting higher investments in these crops (financial and non-financial) which demonstrate to have high potential in reducing the poverty and vulnerability of communities and farming systems; providing guidance for the research and development community on intervention areas.

The project 'Raising Awareness to Create Support for Agricultural Biodiversity' addresses System Priority 2B by raising awareness on underutilized species and translating this into greater appreciation, conservation and use.

The research gaps identified by the project coordinators in the above projects/activities are:

- ✓ lack of studies on consumer preferences for existing species diversity;
- ✓ lack of marketing information, which would improve the demand;
- ✓ lack of research on development for new products' value addition;
- ✓ need for research on the characterization of genetic variability existing within crop wild relatives;
- ✓ need for research on the ecology distribution and threats of many of these crop wild relatives;
- ✓ need for research on trade barriers for underutilized species;
- ✓ lack of research providing evidence on the nutritional value of underutilized crops and lack of concrete data on nutritional values of many underutilized species.

#### *Comparative advantages*

The comparative advantages of Bioversity in carrying out the projects over other centres and stakeholders are the following:

- ✓ It has always worked with all ranges of agrobiodiversity, while all other centres and institutions work on a very limited number of specific crops.
- ✓ It has experience and strong reputation in the field of underutilized species.
- ✓ It has a SGRP coordinating role, global mandate on biodiversity sustainable conservation and use, relevant experience in this field, solid image as honest broker/networker.
- ✓ It is in a unique position to work on crop wild relatives given the flexibility of its *modus operandi*, while most other centres are more focused on crop-improvement programmes.
- ✓ It has experience with Andean fruits, and with working through partnerships.
- ✓ It has experience in water-use efficiency and root morphology.
- ✓ It has experience in compiling catalogues on plant varieties.
- ✓ It has experience in identifying core collections.
- ✓ Through the GFU, Bioversity works on cross-cutting issues relevant for all. Bioversity and GFU also have a global mandate and GFU is supported by a number of institutions outside the CG.
- ✓ Through GFU, Bioversity is not limited to research and can engage in development activities. The selection of partners is also very flexible and the GFU's association with the Global Forum on Agricultural Research (GFAR) is a good vehicle for broad stakeholder involvement and the dissemination of results.

### ***International Centre for Tropical Agriculture (CIAT)***

#### *The projects and activities on underutilized plant species*

The project at MTP level 'Markets, Institutions and Livelihoods' includes three goals in dealing with underutilized species:

- ✓ enhancing competitiveness of smallholder growers of lulo (*Solanum quitoense*) and mora (*Rubus glaucus*) through participatory selection of elite clones, integrated crop management and strengthening of value chains;
- ✓ added-value lulo: alternatives for smallholder producers;
- ✓ dynamics of sources of inocula and analysis of the anthracnose pathogen population infecting tropical fruits.

The above mentioned projects deal with activities such as improving germplasm, improving crop management, access to markets and propagation technologies for rural communities for lulo and mora. They deal with starch quality attributes of populations of peach palm, disease resistance and



management of anthracnose in soursoap and tree tomato, as well as genetic variability. Other activities involve linking smallholder producers to markets, increasing supply-chain information and boosting high value of various crops. The major outputs of the project activities are: elite clones of minor fruit crops, characterization of genetic diversity of major pathogens affecting productivity, molecular characterization of genetic diversity in growers' fields and management strategies for increasing crop production and enhancing competitiveness.

The second project at MTP level involving activities on underutilized species is 'Conservation and use of tropical genetic resources', which includes the project entitled: 'Integrated Conservation of Neo-tropical Plant Genetic Resources'. This project addresses work on collections complying with international standards, with regard to the availability of the collections to users and the patterns of genetic diversity in the wild, as well as the domestication of underutilized bean species. The major outputs of the project are: the multiplication, characterization, conservation and distribution of seed accessions, a better understanding of diversity in conserved collections, and information on how to expand the collections with novel genetic diversity.

#### *List of species addressed by the activities*

English name	Scientific name
lulo	<i>Solanum quitoense</i>
mora	<i>Rubus glaucus</i>
chontaduro, pupunha, pejibaye, pijuayo, peach palm	<i>Bactris gasipaes</i>
soursoap	<i>Annona muricata</i>
tree tomato	<i>Solanum betaceum</i>
lima bean	<i>Phaseolus lunatus</i>
year bean	<i>Phaseolus polyanthus</i>
tepariy bean	<i>Phaseolus acutifolius Acutifolius</i>
sword bean	<i>Canavalia</i>
leucaena	<i>Leucaena</i>

#### *Contribution to the System Priorities and identification of existing research gaps*

The above activities contribute mainly to System Priorities 3A and 1B. The germplasm will be available to end users, along with its relative information.

The following research gaps have been identified in addressing the System Priorities:

- ✓ still very little knowledge of genetic diversity of the agronomic attributes (disease resistance, organoleptic properties) of these species;
- ✓ need for research on breeding by other research organizations (either public or private);
- ✓ lack of technology in production systems;
- ✓ lack of research on the role of organization of smallholder producers;
- ✓ lack of representation of underutilized species in germplasm collection and barrier in the acquisition of new germplasm to better understand the diversity existing in current collections, as several underutilized species are not listed in Annex 1 of the International Treaty;
- ✓ need for studies in nitrogen fixation, namely under drought and heat stresses for tropical legumes, to develop more resilient cropping systems.

#### *Comparative advantages*

The comparative advantages of the centre in carrying out the project over other centres and stakeholders are as follows:

- ✓ being an honest broker which can conform to research consortia in Tropical Fruits;
- ✓ having long-standing expertise in participatory breeding, biotechnology, and social sciences;
- ✓ having a broader and longer-term vision among members of the consortia;

- ✓ keeping the largest and most diverse collections in the world of underutilized tropical legumes, either as pulses or as forages;
- ✓ having in-house germplasm specialists, breeders and biotechnologists.

## **International Potato Centre (CIP)**

### *The projects and activities on underutilized plant species*

The project at MTP level ‘Genetic Resources Conservation and Characterization’ includes two projects dealing with underutilized species. The first one is entitled ‘Conservation’. The project deals with activities, such as the collection of wild and cultivated genetic resources of Andean roots and tubers (ART) and associated information; conservation of the material through integrated *ex-situ*, *in-situ*, and on-farm approaches; dissemination of material to end users.

The major outputs of this project are:

- ✓ 1,428 accessions of oca, ulluco, mashua, arracacha, achira, yacon, maca mauka, and yam bean securely maintained (1,137 *in vitro*, 1,000 as field collections, 60 under a long-term program, and 200 wild allies);
- ✓ on-farm conservation of 72 cultivars of oca, 68 of mashua, and 29 of yacon in six traditional farming communities in Cusco, Peru.

The second project is entitled ‘Genetic characterization and evaluation’. It addresses the morphological and molecular characterization and evaluation of wild and cultivated genetic resources of ART.

The main outputs of the project are:

- ✓ 951 accessions of ART morphologically characterized (427 of oca, 344 of ulluco, 107 of mashua, 37 of arracacha, and 36 of yacon);
- ✓ the study of genetic diversity of 772 accessions of Andean tubers maintained *ex situ* by CIP (585 of oca, and 187 of ulluco); genetic diversity of 791 accessions of Andean tubers determined and maintained on farm by six rural communities (475 of oca, 92 of mashua, and 44 of ulluco);
- ✓ glucosinolate content of 340 accessions of mashua evaluated and maintained on farm by six rural communities, and 92 maintained *ex situ* by CIP;
- ✓ antioxidant capacity and secondary metabolites of 15 accessions of ulluco, 14 of oca, and 11 of mashua clearly determined.

### *List of species addressed by the activities of both projects*

English name	Scientific name
oca	<i>Oxalis tuberosa</i>
ulluco	<i>Ullucus tuberosus</i>
mashua	<i>Tropaeolum tuberosum</i>
arracacha	<i>Arracacia xanthorrhiza</i>
achira	<i>Canna indica</i>
yacón	<i>Smallanthus sonchifolius</i>
maca	<i>Lepidium meyenii</i>
mauka	<i>Mirabilis expansa</i>
yam bean, Andean yam bean, Manioc bean	<i>Pachyrhizus ahipa</i>
ajipo	<i>Pachyrhizus tuberosus</i>
yam bean	<i>Pachyrhizus erosus</i>
Wild allies	<i>Oxalis, Ullucus, Tropaeolum, Arracacia, Canna, Smallanthus, Lepidium, Mirabilis, and Pachyrhizus</i>

Although the project ‘Genetic resources conservation and characterization’ is the only project at MTP level including work on underutilized plant species (ART), the other MTP level project on ‘Germplasm Enhancement and Crop Improvement’ mentions underutilized species, and the project

on 'Urban Harvest' mentions leafy vegetables and indigenous vegetables. It is likely that other divisions will expand their activities related to underutilized ART in the near future.

#### *Contribution to the System Priorities and identification of existing research gaps*

The contribution to the target System Priorities of project 1 and project 2 are provided as follows:

1B: 1) repatriating healthy Andean tubers (staples) to restore biodiversity in communities where these genetic resources have been either reduced or lost; 2) identifying promising material (yield, nutrition, and functional properties);

2B: 1) providing promising material to users 2) identifying promising material as a way to move forward;

3A: 1) developing strategies for integrated management of ART crops in traditional farming communities; 2) diffusing the functional properties of promising material;

4D: 1) distributing healthy material to users; 2) developing strategies for integrated crop management;

5B: 1) diffusing the main features of ART as functional foods 2) developing value-added products;

5D: 1 and 2) alliances with national and international institutions.

The research gaps identified in fully addressing the System Priorities are:

- ✓ need for improvement in traditional storage systems;
- ✓ need to develop a systematic indigenous knowledge documentation system;
- ✓ lack of research in improving traditional processing to add value to the underutilized crops.

#### *Comparative advantages*

The comparative advantages of having the centre carry out the project over other centres and stakeholders are the following:

- ✓ Being located in the centre of diversity for ART, collaboration with local farmers is easier.
- ✓ Facilitating field collection conservation in rural communities preventing the *ex-situ* material from losses;
- ✓ Facilitating on-farm management of Andean tubers as a system.

## **International Center for Agricultural Research in Dry Areas (ICARDA)**

### *The projects and activities on underutilized plant species*

ICARDA carries out the following projects/activities related to underutilized plant species:

1. 'Research in production and marketing of saffron as an alternative to opium poppy cultivation', to promote the sustainable production of saffron, a suitable drought-resistant crop, in project areas, through the establishment of institutional structures for processing and marketing of products;
2. 'Village Decision Driven Research Project', to develop research activities for alternatives to poppy production (such as *Prunus*, *Quercus*, *Juglans*) by building the capacity for the Ministry of Agriculture and Animal Husbandry from a structure that integrates needs identified by village organizations in Alingar, a district in the province of Laghman;
3. 'Cultivation of mint as a viable livelihood alternative in East and North East of Afghanistan', to promote its production and marketing for culinary and medicinal purposes and for oil-extraction as a basis for value-added products;
4. 'Improved rural incomes from better forage production and sales of milk products', to enhance the use of rainfed and irrigated arable land for the sustainable production of forage crops (*Medicago*, *Avena*, *Lathyrus*) through improved agronomy practices for livestock, resulting in better milk products and consequent income;
5. 'Western Afghanistan Agroenterprise Action Research Program', to identify on-farm and off-farm livelihood options in Ghor Province, in particular, high-value crop production, marketing opportunities and small-scale value-adding activities (cumin);

6. 'Increased Productivity and Profitability of Wheat-based Cropping Systems to Reduce Reliance on Opium Poppy in Northern Afghanistan', to work with farmers in developing new high-value livelihood options (*Sesamum, Carthamus, Linum*);
7. 'Multi-Stakeholder Programme on Natural Ingredients for Food, Pharmaceuticals and Cosmetics in Afghanistan', to develop natural products coming from wild-collected plants (*Glycyrrhiza, Carum, Artemisia, Ziziphus jujuba*) by improving knowledge of and access to processing technologies, in order to improve quality and market access;
8. 'ADB: Enabling communities in the Aral Sea basin to combat land and water resource degradation through the creation of "bright" spots', to develop and adopt innovative technologies in order to enhance productivity, introducing *Ziziphus jujuba* and *Medicago sativa* into the crop rotation;
9. 'Biological Diversity, Cultural and Economic Value of Medicinal, Herbal and Aromatic Plants in Morocco', to study the economics and marketing of medicinal, herbal and aromatic plants (*Lavandula, Salvia, Crocus, Ocimum*);
10. 'Applied research component of project GCP/PAK/095/USA "Food Security/Poverty Alleviation in Arid Agriculture Balochistan - Pilot Project Phase"', for the evaluation of germplasm and management options of high-value crops (pistachio and pomegranate, *Berberis, Prunus, Panicum*) and medicinal plants (cumin); introduction of germplasm with drought tolerance and with high-market quality to improve the livelihoods of rural people in Balochistan;
11. 'Appropriate methods of restoration ecology and specifically trials for the successful establishment of the key forage species "shrubs and grasses" for degraded sites', to improve rangeland management and promote intensive rehabilitation (*Salsola, Haloxylon, Atriplex, Cenchrus ciliaris, Panicum turgidum* and *Pennisetum divisum*);
12. 'Biotechnology development in Arab World', to increase understanding of the drought-tolerance mechanism in dryland crops (wheat wild relatives) and develop expertise in the NARS in functional analysis (molecular marker, tissue culture and genetic engineering);
13. 'Community Action in Integrated and Market Oriented Feed-Livestock Production in Central and South Asia', to develop and promote community-based actions in order to support productive and sustainable livestock systems, access to market opportunities, and sustainable management of the natural resource base (annual and perennial fodder species) in the region;
14. 'Rehabilitation of Agricultural Livelihoods of Women in Marginal Post-Conflict Areas of Afghanistan and Pakistan', to improve skills and knowledge of rural women in marginal and conflict/post-conflict areas in coping with shock, through better use of the natural resource base in raising dairy goats, planting techniques, processing and marketing the surplus products (*Ziziphus, Medicago, Acacia, Atriplex*);
15. 'Improving Rural Livelihoods through Efficient On-Farm Water and Soil Fertility Management in Central Asia', for the adoption by farmers of technological and institutional innovations that conserve soil and water, are sustainable and input-use efficient and generate greater economic returns to rural households (*Cydonia, Ziziphus, Elaeagnus - oleaster*);
16. 'Enhancing the productivity of salt-prone land and water resources to ensure sustainability of smallholder crop-livestock farmers in West and Central Asia', to develop biophysical interventions and promote institutional and policy options for sustainable and integrated use of saline water and salt-affected soils for food/feed crops, grasses, fodders and forage legumes;
17. 'Enhancing Livelihoods of Poor Livestock Keepers through Increased Use of Fodder in Syria', to work with partners and farmers in strengthening the capacity of poor livestock keepers to select and adopt fodder options and access market opportunities, in order to enable them to improve their livelihoods and the sustainability of their farming systems;
18. 'Commodity Chain Analysis for Selected Medicinal and Aromatic Plants (MAPs) in the Near East and North Africa (NENA) Region', to carry out commodity chain analysis for selected MAPs with comparative advantage and potential to benefit the small growers/collectors;

19. 'Commodity chain analysis for selected horticultural exports in the NENA region', to undertake commodity chain analysis for selected horticultural commodities (*Prunus*, *Pistacia* in the arid and semi-arid rainfed mountainous areas of Morocco);
20. 'Genetic Resource Conservation, Documentation and Utilization in Central Asia and the Caucasus', to facilitate the development of a long-term regional capacity to collect, conserve, document, utilize and exchange PGR (food legume landrace and wild relatives); develop a comprehensive national and regional PGR information system that will allow plant breeders to more efficiently identify and utilize their PGR.

*List of genus/species addressed by the activities*

English name	Scientific name
saffron	<i>Crocus sativa</i>
stone fruits	<i>Prunus</i>
oaks-	<i>Quercus</i>
walnuts	<i>Juglans</i>
basil	<i>Ocimum</i>
mints	<i>Mentha</i>
cumin	<i>Cuminum cyminum</i>
sesame	<i>Sesamum</i>
safflower	<i>Carthamus</i>
linseed	<i>Linum</i>
liquorice	<i>Glycyrrhiza glabra</i>
caraway	<i>Carum carvi</i>
levant wormseed	<i>Artemisia cina</i>
jujube	<i>Ziziphus jujuba</i>
alfalfa	<i>Medicago sativa</i>
--	<i>Acacia</i>
--	<i>Lavandula</i>
--	<i>Salvia</i>
pistacchio	<i>Pistacia</i>
pomegranate	<i>Punica granatum</i>
--	<i>Berberis</i>
--	<i>Salsola</i>
--	<i>Haloxylon</i>
saltbush	<i>Atriplex halymus</i>
buffelgrass	<i>Cenchrus ciliaris</i>
desert grass	<i>Panicum turgidum</i>
sabth grass	<i>Pennisetum divisum</i>
quince	<i>Cydonia oblonga</i>
oleaster	<i>Elaeagnus</i>
wheat wild relatives	
fodder species	
food legume landrace and wild relatives	
grasses	
MAPs	

*Contribution to the System Priorities and identification of research gaps*

Project 9 contributes to System Priority 1B; Project 12 contributes to System Priority 2B; Projects 2 and 20 contribute to System Priority 3A; Projects 1, 3, 4, 6, 7, 10, 13, 14, 15, 16, 17 and 18 contribute to System Priority 4D; Projects 1, 3, 7 and 20 contribute to System Priority 5B.

The research gaps identified concern the characterization of genetic diversity of underutilized plant species and crop wild relatives and their germplasm collection.

*Comparative advantages*

ICARDA owns a germplasm collection and facilities, and has in-house specialists to carry out diversity studies on target species.

## **International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)**

### *The projects and activities on underutilized plant species*

The project at MTP level ‘Reducing Rural Poverty through Agricultural Diversification and Emerging Opportunities for High-Value Commodities and Products’ includes a project dealing with underutilized species entitled ‘Collection, Evaluation of Germplasm, Standardization of Agro-techniques and Pilot demonstration for *Jatropha curcas* L. in Rain Shadow Districts of Andhra Pradesh’. The project activities are: the evaluation of *Jatropha* germplasm supplied by the National Bureau of Plant Germplasm Research (NBPGR), Hyderabad, India, in the respective centres, both in nursery and main plantations; and the standardization of agro-techniques. The major outputs are:

- ✓ the standardization of hi-tech nursery technologies for faster plant growth of *Jatropha* and *Pongamia* and better establishment;
- ✓ identification of suitable crops to be grown as intercrop in *Jatropha* plantations;
- ✓ identification of divergent lines and suitable agronomic practices for example fertility trivalent, spacing etc.;
- ✓ development of suitable agronomic and pruning techniques for early and increased productivity of *Jatropha* and *Pongamia* and collection and analysis of information on economic benefits.

### *List of species addressed by the activities in Andhra Pradesh India*

English name	Scientific name	Activities
jatropha	<i>Jatropha curcas</i>	Evaluation of germplasm
pongamia	<i>Pongamia (Milletia) pinnata</i>	Standardization of agro-techniques

### *Contribution to the System Priorities and identification of existing research gaps*

The above activities are in accordance with System Priority 3 – reducing rural poverty through agricultural diversification and emerging opportunities for high-value commodities and products, and in particular, it targets Priority 3A.

The research gap identified in fully addressing the System Priorities is the fact that these crops are addressed very poorly or almost not at all by research studies and that there is a lack of data on all of their aspects.

### *Comparative advantages*

ICRISAT has various comparative advantages in carrying out the above project over other centres and stakeholders. For example, the centre has worked using a multi-disciplinary and multi-institutional “consortium” approach along with the national agricultural research systems (NARSs), non-governmental organizations (NGOs) and the farming communities in many Asian countries, in order to carry out on-farm developmental research. Moreover, ICRISAT’s watershed participatory research and development approach has resulted in a new rural development paradigm where water-management knowledge is used as an entry point for improving rural livelihoods, improving the productivity of rainfed systems and increasing incomes through empowerment.

## **International Food and Policy Research Institute (IFPRI)**

### *The projects and activities on underutilized plant species*

The project at MTP level ‘Genetic Resource Policies for the Poor: Biodiversity and Biotechnology Policies’ includes two projects dealing with underutilized species.

The first project is entitled ‘Marketing underutilized species for the poor’ and carries out the activities of developing a conceptual framework, conducting case studies on necessary conditions for successful commercialization of some underutilized plant species and establishing policy

guidelines. The major outputs of this project are publications, including IFPRI discussion papers, GFU reports, book chapters and journal articles, as well as presentations at international conferences and material for training courses.

The second project is ‘Using markets to promote the sustainable utilization of crop genetic resources’. The project addresses work on the development of project concepts, methodology for the seed systems work on minor millets, study sites selection and sampling framework, and field implementation schedule. Other activities include the implementation of markets and household surveys and conduction of market and household seed-diversity studies, and morphological characterization through grow-outs for Kolli Hills and Dharmapuri Plains. The major outputs of this project are: draft reports on grain and seed value chain analysis; draft reports on minor millets seed sector study; contribution to a discussion paper and GFU reports on minor millets; presentations for international conferences, conduction of consumer awareness events in collaboration with M.S.Swaminathan Research Foundation for popularizing minor millet consumption among urban consumers.

*List of species addressed by the activities and countries*

English name	Scientific name	Country
scarlet eggplant, garden egg	<i>Solanum aethiopicum</i>	Ghana
quinoa	<i>Chenopodium quinoa</i>	Bolivia
little millet	<i>Panicum sumatrense</i>	India
foxtail millet	<i>Setaria italica</i>	
finger millet spp.	<i>Eleusine coracana</i>	

*Contribution to the System Priorities and identification of existing research gaps*

The first project contributes to 1B indirectly, as the project identifies and analyzes institutional mechanisms for the use of underutilized species. The conceptual framework also helps to distinguish those species for conservation and those for market development. There is also an indirect contribution to 3A in specific case studies. System priority 5B is addressed by the first project by focusing on market constraints and market development for underutilized species and, therefore, identifies the constraints and potential solutions in order to increase market access and the efficiency of markets for small holders, while promoting crop diversification. The research project also addresses the need for supply control mechanisms, i.e. schemes that facilitate product differentiation.

Regarding the research gaps, there is still little knowledge about the market constraints and market development for underutilized species benefiting the poor, and it is based on case studies. Extensive research in this field is needed.

*Comparative advantages*

The comparative advantages of having the centre carry out these projects over other centres and stakeholders lie in the centre’s expertise in applied economics and policy analysis. While case studies are conducted in different centres and institutions, IFPRI specifically focuses on policies and the economic aspects of market development for underutilized species, and possesses in-house expertise to draw policy lessons.

**International Institute of Tropical Agriculture (IITA)**

*The projects and activities on underutilized plant species*

IITA conducts the following projects reported at MTP level:

- ✓ Root and Tuber Systems
- ✓ Agrobiodiversity

The project ‘Root and Tuber Systems’ includes activities such as the identification of sources of high food quality and functional characteristics in yams; studies on marketing channels and market efficiency for yams in West and Central Africa; identification of biological control to restrain tuber rot in yams; preparation of business plans for setting up small-to-medium scale seed yam production units; assessment of the effects of trade and market liberalization on technology adoption to increase productivity in the yam sub-sector; identification of expressed sequence tags in *D. alata*; production of interspecific hybrids among *Dioscorea* species. The major outputs of this project are:

- ✓ prioritizing policy, input/output market, post-harvest, and production constraints
- ✓ describing biotic and abiotic processes and interactions
- ✓ improving root and tuber germplasm
- ✓ integrating improved component technologies
- ✓ assessing the commercial viability of agro-enterprises
- ✓ developing strategies for enhancing technology-adoption potential

*List of species addressed by the activities and countries*

English name	Scientific name	West and Central Africa
white Guinea yam	<i>Dioscorea rotundata</i>	
water (greater) yam	<i>Dioscorea alata</i>	
yellow Guinea yam	<i>Dioscorea cayenensis</i>	
trifoliolate (bitter) yam	<i>Dioscorea dumetorum</i>	

The project ‘Agrobiodiversity’ includes a project entitled ‘Characterisation, documentation, sanitation, regeneration of cow pea relative and other under-used species’, which carries out the activities of identification, morphological characterization, passport data compilation and computerization, sanitation and regeneration of bambara groundnut and green gram; seed storage, monitoring and arboretum maintenance of various underutilized species; reproductive biology and genetic diversity study of African yam beans, *in-situ* conservation, field conservation and *in vitro* duplication of *Dioscorea* germplasm. The major outputs of this project are: the availability for distribution of various underutilized species germplasm, promotion of agronomical research on African yam bean and maintenance of underutilized tree germplasm.



*List of species addressed by the activities and related activities*

English name	Scientific name	Activities
Bambara groundnut	<i>Vigna subterranea</i>	Identification / characterization / passport data / sanitation / regeneration
green gram	<i>Vigna radiata</i>	
cowpea	<i>Vigna unguiculata</i>	reproductive biology and genetic diversity study
African yam bean	<i>Sphenostylis stenocarpa</i>	
black wattle, Hickory wattle and mangium	<i>Acacia mangium</i>	
pigeonpea	<i>Cajanus cajan</i>	
velvetbean	<i>Mucuna deeringiana</i>	
velvetbean	<i>Mucuna pruriens</i>	
pearl millet	<i>Pennisetum americanum</i>	
lima bean	<i>Phaseolus lunatus</i>	
manila Tamarind	<i>Pithecellobium dulce</i>	
sesame	<i>Sesamum indicum</i>	
Egyptian riverhemp, common sesban, Egyptian rattle pod, river bean, sesban, sesbania	<i>Sesbania sesban</i>	
African yam bean	<i>Sphenostylis stenocarpa</i>	
rice bean	<i>Vigna umbellata</i>	
zombi pea	<i>Vigna vexillata</i>	
Bambara groundnut	<i>Vigna subterranea</i>	
green gram	<i>Vigna radiata</i>	
auri, earleaf acacia, earpod wattle, northern black wattle, papuan wattle, tan wattle	<i>Acacia auriculiformis</i>	
pod mahogany	<i>Azelia bella</i>	
soursop	<i>Annona muricata</i>	
akee, akee apple, aki	<i>Blighia sapida</i>	
white star apple	<i>Chrysophyllum albidum</i>	
black velvet, velvet tamarind	<i>Dialium guineense</i>	
guaba, guaba de bejuco, guama, inga cipo	<i>Inga edulis</i>	
wild mango	<i>Irvingia gabonensis</i>	
moringa	<i>Moringa oleifera</i>	
African locust bean, dombou, néré	<i>Parkia biglobosa</i>	
avocado	<i>Persea americana</i>	
guava	<i>Psidium guajava</i>	
golden apple, hog plum, yellow mombin	<i>Spondias mombin</i>	
peanut tree, beer tree, monkeynut tree	<i>Sterculia quadrifida</i>	
African-breadfruit	<i>Treculia africana</i>	
ewuro, bitter leaf, etidot	<i>Vernonia amygdalina</i>	
cliricidia, nicaraguan cocoa shade, quick-stick, cacahuananche, madre de cacao	<i>Gliricidia sepium</i>	Maintained in seed bank and arboretum
leucaena, lead tree, white popinac	<i>Leucaena leucocephala</i>	
turburku, ito	<i>Millettia thonningii</i>	
African mesquite	<i>Prosopis africana</i>	
African padauk	<i>Pterocarpus osun</i>	
no common name (yam)	<i>Dioscorea togoensis</i>	
igname étoilé	<i>Dioscorea hirtiflora</i>	
no common name (yam)	<i>Dioscorea abyssinnica</i>	field bank, <i>in vitro</i> duplication
winged yam; water yam; white yam;	<i>Dioscorea alata</i>	
yellow Guinea yam	<i>Dioscorea cayenensis</i>	
lesser yam; asiatic yam;	<i>Dioscorea esculenta</i>	
no common name (yam)	<i>Dioscorea mangelotiana</i>	
white Guinea yam	<i>Dioscorea rotundata</i>	
yam	<i>Dioscorea bulbifera</i>	field bank, <i>in vitro</i> duplication, <i>in situ</i>
trifoliolate (bitter) yam	<i>Dioscorea dumetorum</i>	
no common name (yam)	<i>Dioscorea preusii</i>	
bush yam, forest yam	<i>Dioscorea praeheensis</i>	

### *Contribution to the System Priorities and identification of existing research gaps*

The project on 'Roots and Tuber Systems' contributes to System Priorities 2B, 4D, 5B and 5D, while the project under 'Agrobiodiversity' contributes to 1B, as it addresses the maintenance, characterization, documentation, and sanitation of underutilized plant species.

The research gaps identified by the project managers are the following:

- ✓ development of biotechnology tools (molecular markers, transformation protocols, etc.)
- ✓ research on arthropod pests
- ✓ studies on mechanisms for host plant resistance
- ✓ social research on promotion and consumption of underutilized species, and flexibility in people's diet changes.

### *Comparative advantages*

The comparative advantages of having the centre carry out these projects over other centres and stakeholders lies in:

- ✓ owning the best collection of *Dioscorea* germplasm
- ✓ being based in Africa, which accounts for about 96% of the world's production and consumption of yams; the institute's headquarters is in the sub-region, which accounts for over 90% of global production;
- ✓ Africa is also the origin of the most cultivated species and IITA has direct access to valuable indigenous knowledge from yam growing communities.
- ✓ Having multiple locations in Sub-Saharan Africa and being close to the centre of origin of many underutilized species located in this region, as well as to crop users;
- ✓ experience and long-established partnerships with local and international agencies relevant to R&D activities on these crops.

## **World Agroforestry Centre (ICRAF)**

### *The projects and activities on underutilized plant species*

The World Agroforestry Centre works in more than 28 countries on more than 300 tree species, most of which can be considered underutilized. At MTP level, two global projects have been identified as addressing underutilized plant species:

- 'Tree Domestication and management of tree genetic resources'
- 'Tree product market'

The global project on 'Tree Domestication and management of tree genetic resources' addresses activities on agroforestry germplasm, molecular characterization of priority tree species, tree diversity and abundance baselines in Southern Africa and South Asia, methods for scaling up germplasm collection, and research on links between farm trees and environmental services. Research on tree domestication involves activities on trials of improved propagules and controls (genetic gain and farm compatibility), economics of agroforestry products, mycorrhizal infections and dependency on *Allanblackia*, research on biodiesel species (*Jatropha*, *Moringa*, *Pongamia*), links between health and agroforestry fruits influencing the species and cultivar selection, and agroforestry fruit-tree management (spacing, watering, pruning, fertilization, and harvesting methods). Other extensive research and development work is conducted on a great range of species including the vegetable tree moringa (*Moringa oleifera*), the safou plum (*Dacryodes edulis*), the fruit trees *Irvingia gabonensis*, and *Sclerocarya birrea*, and the medicinal African plum (*Prunus africana*), and many others<sup>6</sup>.

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<sup>6</sup> Geoffrey Hawtin. July 2007. Underutilized Plant Species Research and Development Activities – Review of issues and options. A report submitted to the chairs of the GFU Steering Committee and the ICUC Scientific Advisory Board

The global project on ‘Tree product market’ includes activities on markets for agroforestry tree products, covering quality characterization of tree products across their geographical ranges (e.g., shea butter in West Africa); and research related to aspects of agroforestry enterprise in tree nurseries, tree growing/harvesting, and marketing. In particular, the project on ‘Vegetation maps for land rehabilitation’ develops maps helping communities pick the right indigenous trees for their farms providing information on more than 300 forest species (many of them underutilized, see Annex 5) on timber, fruit, watershed protection, biodiversity and other services (source of information [www.worldagroforestrycentre.org](http://www.worldagroforestrycentre.org), accessed on November 12, 2007).

Nevertheless, only one project was reported through the present survey by centre project coordinators. The project is entitled ‘Allanblackia: A new tree crop for Africa’, which falls under the MTP level project ‘Tree Domestication and management of tree genetic resources’. The activities are the development of germination protocols and of best approaches for different aspects of *Allanblackia*’s value chain, from domestication, on farm planting to collection and then the processing of oil to collect 6 *Allanblackia* species. Molecular work is being undertaken to ensure high productivity, for example, work on gene flow, genetic diversity, and genebanks. The major outputs of the project are: the development of germination and propagation protocols, the establishment of farmer networks for collection and the development of SSR markers, as well as the diversity analysis of the *Allanblackia* species.

*Species addressed by the activities*

The species addressed in the project ‘Allanblackia: A new tree crop for Africa’ reported by the coordinator is:

English name	Scientific name	
Allanblackia	<i>Allanblackia</i> spp.	Africa

*Contribution to the System Priorities*

The projects and activities in the global project on ‘Tree product market’ mainly address System Priority 3A.

The contribution to the following System Priorities of the project ‘Allanblackia: A new tree crop for Africa’ are:

- 1B - promoting on farm planting, there is a contribution to natural habitats and knowledge generated on *Allanblackia* species;
- 2B – selecting better, more productive genotypes;
- 3A – working on the link with private sector (Unilever), which showed commitment in buying *Allanblackia* oil from small-holder farmers;
- 4D – on-farm planting of this forest tree contributes to forest management;
- 5B – making the link with the private sector that has interest in buying the oil (Unilever and other companies);
- 5D – work on policies is being advanced.

*Comparative advantages*

*Allanblackia* is a tree that requires domestication. One of the comparative advantages of having the centre carry out the project over other centres and stakeholders is that the World Agroforestry Centre has a lot of experience in this field. Moreover, the centre has been involved in other public and private collaborations for long time, so that the processes of the public-private partnerships in developing a sustainable market benefiting the small-holder farmers are not new to the centre.

## **Africa Rice Centre (WARDA)**

### *The projects and activities on underutilized plant species*

The project at MTP level ‘Integrated Rice Production Systems’ includes two projects dealing with underutilized plant species:

- i) Enhancing the Performance of Irrigated Rice-based Systems in Africa;
- ii) Sustainable Intensification of Lowland Rice-based Systems for Enhanced Livelihoods.

The projects deal with activities on new high-value vegetable or field crop options to fit a rice-based system and on the intensification and diversification opportunities, including rice and rice-vegetable integration. The major outputs are a stable and profitable crop diversification in lowland rice systems and integrated crop and natural resources management (ICNRM) options for improved resource-use efficiency and mitigation of degradation in irrigated rice-based systems.

### *List of species addressed by the activities*

English name	Scientific name
okra	<i>Abelmoschus esculentus</i>
eggplant	<i>Solanum melongena</i>
pepper	<i>Capsicum annum</i>
amaranth	<i>Amaranthus esculentus</i>

### *Contribution to the System Priorities and identification of existing research gaps*

The above projects contribute to the target System Priorities in the following way:

1B – by collecting, storing, evaluating and characterizing the landraces of these vegetables in West Africa;

3A – reducing rural poverty through rice based diversification and emerging opportunities for high-valued vegetables in West Africa.

The research gap identified by the project coordinators is the very limited knowledge of the level of diversity that exists in the vegetable collection of West Africa and the lack of well documented information.

### *Comparative advantages*

WARDA has identified the following comparative advantages in carrying out the above project over other centres and stakeholders:

- ✓ WARDA works directly with the national system and the poor rice small farmers of Africa (mostly women), who also cultivate vegetables along rice fields.
- ✓ WARDA has skilled human resources with good knowledge of data base management, characterization and evaluation of plants.
- ✓ WARDA owns genebank facilities for the conservation of these vegetables.
- ✓ The Genetic Resources Unit of WARDA has the capacity to identify genetic diversity with new alleles to make it available for utilization.

WARDA is also preparing a research project in collaboration with IITA entitled “Valorisation of underutilized indigenous vegetables grown in West African lowland rice systems”.

## **International Maize and Wheat Improvement Center (CIMMYT)**

CIMMYT is not yet engaged in projects dealing with underutilized plant species. However, it is starting to do work on markets for differentiated (de-commodified) maize products (e.g. markets for particular landraces).

## **International Rice Research Institute (IRRI)**

The revision of the MTPs did not show any project or activity directly related to underutilized plant species. However, through the survey, it was reported that IRRI works on wild relatives of rice and *Azolla* spp. (mosquito fern).

## **Synthesis and analysis of the results**

From the survey carried out and the replies obtained from project coordinators, it results that 9 centres out of the 15 (60% total) are working on a wide range of projects and activities related to underutilized species, and that one centre is in the initial stages of developing activities. The remaining 5 centres are not currently working on projects related to underutilized plant species. Table 6 in Annex 1 gives a synthetic overview of the projects, type of activities and names of project coordinators.

### **Synthesis: CG centres with projects/activities on underutilized species**

**Bioversity International** has rather extensive projects and activities on underutilized plant species, working on 6 main projects reported at MTP level, 15 small and big projects focusing on underutilized species and some 19 different activities related to these species. Main activities covered by the projects are diversity assessment and documentation on these species, the improvement of the market chain, market access and value-addition of products derived from these species, as well as training, capacity building, and awareness raising with regard to the importance of these species for nutrition and income generation. Policy recommendations for better use and conservation are main outputs for some projects. One of the projects is the ‘Global Facilitation Unit for Underutilized Species (GFU)’. In addition to these projects and activities, Bioversity carries out a list of tasks related to underutilized plant species, for instance training courses, etc. Bioversity is involved in activities related to underutilized species in everyday work, with a focus on institutions as well as programs. An important comparative advantage of Bioversity is that it has always worked with all ranges of agrobiodiversity, and it has gained a great deal of experience and prestige in the field of underutilized species. The centre does not concentrate its work only on a few species or in certain countries, but it ranges amongst all the defined neglected and underutilized species and crop wild relatives, working on groups of species defined for each project or conducting case-study research for each project/activity. Furthermore, it has global coverage through projects worldwide. The activities carried out at Bioversity address all the target System Priorities and, in particular, System Priorities 1B, 3A and 5 B. Some of the major research gaps identified in achieving the target priorities are related to the lack of research in the fields of marketing, value-adding, consumers’ preferences, trade barriers and the nutritional values of these species.

**CIAT** works on two projects reported at MTP level on underutilized plant species and on four projects overall. The main activities carried out in the projects are related to the improvement of germplasm, crop management, access to markets and propagation technologies; the multiplication, characterization, conservation and distribution of seed accessions; and a better understanding of diversity in conserved collections. The species are mainly underutilized tropical fruits and legumes. CIAT’s main comparative advantage is in keeping collections of these species and having in-house germplasm specialists, breeders and biotechnologists. The projects address mainly System Priorities 3A and 1B. The main research gaps identified at CIAT concern knowledge in genetic diversity, breeding, production system technologies and producers’ organization on these species.

**CIP** has one project reported at MTP level on underutilized plant species and two sub-projects covering activities such as the collection of wild and cultivated genetic resources of Andean roots and tubers species; their morphological and molecular characterization; conservation *in situ*, *ex situ* and on farm of the material; and dissemination to the end users. CIP has a comparative advantage of

being located in the centre of diversity of these species and working in direct contact with local farmers managing these species. It owns genebank facilities for the conservation of the genetic material and has in-house specialists for on-farm management and *ex-situ* conservation. One project addresses all the target System Priorities, while the other project tackles mainly System Priorities 3A and 5D. The main research gaps identified at CIP are in the improvement of traditional storage systems, the indigenous knowledge documentation system, and traditional processing and value-addition to the products derived from these species.

**ICARDA** works on some twenty projects/activities related to underutilized plant species in West and Central Asia and Caucasus and North Africa (specifically in Morocco, Syria, Afghanistan, and Pakistan). The activities covered by these projects are the production, processing, marketing, and value addition of the target species; evaluation of germplasm and management options; introduction of germplasm with drought tolerance; and capacity building for national institutions on species management. The species addressed by ICARDA's activities are MAPs, fruit trees, fodders, legume and wheat landraces and wild relatives. ICARDA's projects address System Priorities 1B, 2B, 3A, but most of them tackle System Priorities 4D and 5B. ICARDA's comparative advantages are the in-house specialists in research on germplasm, breeding, biotechnology and the genebank facilities.

**ICRISAT** has one project at MTP level and a sub-project on underutilized species covering activities such as the evaluation of germplasm in nurseries and plantations, and the standardization of agro-techniques for *Jatropha* and *Pongamia* species in the Districts of Andhra Pradesh. The project tackles System Priority 3A. ICRISAT's comparative advantage is its experience using a multi-disciplinary and multi-institutional "consortium" approach along with the NARSs, NGOs and farming communities in many Asian countries, with regard to participatory research and development work addressing the improvement of rural livelihoods relying on rainfed production. The main research gap identified by ICRISAT is the lack of data in general on all aspects of these crops.

**IFPRI** works on a project covering underutilized species at MTP level, entailing two sub-projects dealing with activities such as the development of case studies (quinoa in Bolivia, garden egg in Ghana, and minor millets in India) on market access commercialization of these species and on policy guidelines on conditions necessary to improving this. Other activities relate to the seed system and morphological characterization of some species (minor millets in India). The projects address System Priorities 1B, 3A and 5B. The comparative advantages of the centre consist of possessing the expertise in applied economics and policy analysis of market development for underutilized species allowing it to draw policy lessons.

**IITA** has two projects at MTP level dealing with underutilized species, including two sub-projects. The activities covered by the projects vary from the identification, morphological characterization, and functional characteristics (including food quality) of the species, to the seed storage, genetic diversity studies, conservation *in situ* and in arboretum and *in vitro* duplication. Other activities are the market chain studies, and the assessment of the effect of trade and market liberalization on technology adoption to increase productivity. The main species addressed in West Africa are the African yam species, the bambara groundnut and green gram. The projects tackle System Priorities 1B, 2B, 4D, 5B and 5D. IITA identified research gaps in the development of biotechnology tools, in mechanisms for host plant resistance, in social research on promotion and consumption of underutilized species, and flexibility in people's diet changes. IITA's comparative advantage lies in the fact that it is positioned in the greatest yam production and consumption area worldwide, and owns the best collection of *Dioscorea* germplasm. Having multiple locations in Sub-Saharan Africa, IITA is close to the centre of origin of many underutilized species located in this region and has direct access to indigenous knowledge related to them, in particular for yam. IITA has well

established partnerships with local and international agencies working on R&D activities on these crops.

**World Agroforestry Centre (ICRAF)** works on one project at MPT level including a sub-project dealing with underutilized species. However, the centre works on many forest species that can be considered underutilized. The activities covered by the project relate to the development of germination protocols and best approaches for different aspects of the species *Allanblackia*'s value chain in Africa, from domestication and on-farm planting to collection and the processing of oil. Work on genetic diversity is also done to ensure high productivity. The project addresses all the target System Priorities. The comparative advantages of ICRAF in this field are its experience in the domestication of these species and proficiency in public-private collaborations for market development.

**WARDA** has one project at MTP level embracing two sub-projects dealing with underutilized species and tackling activities on new high-value vegetables (with species like okra, eggplant, pepper and amaranthus) or field crop options to fit a rice-based system and on the intensification and diversification opportunities, including rice and rice-vegetable integration. The System Priorities targeted by the projects are 1B and 3A. The research gap identified by the centre is its limited knowledge of the level of diversity existing in the vegetable collection. WARDA has a number of comparative advantages in carrying out this project on underutilized vegetables, such as the experience of working directly with small farmers producing the underutilized species along rice fields, owning genebank facilities for the conservation of the genetic material and the capacity to identify the diversity of these genetic materials and make them available to the end users.

**CIMMYT** is not yet involved in work dealing with underutilized plant species. Nevertheless, the centre is in an initial phase of a work on markets for specific, differentiated landraces of maize (de-commodified production).

**IRRI** did not report any projects on underutilized plant species. However, they work on wild relatives of rice and *Azolla* spp. (mosquito fern).

### ***Analysis: Species studied in CG projects/activities***

As we saw in the description of the projects/activities for each centre, the CG centres work on a wide range of underutilized plant species. Table 1 shows where there are efforts on the same species from more than one centre. Exchange of information on the projects could be of mutual benefit. However, there is no overlap in the research on the same species, as the centres address different research issues.

**Table 1: Underutilized plant species addressed by CG centres' projects and activities**

Species name	Bioversity	CIAT	CIP	ICARDA	ICRISAT	IFPRI	IITA	ICRAF	WARDA
<i>Abelmoschus esculentus</i>	X								X
<i>Acacia auriculiformis</i>							X		
<i>Acacia mangium</i>							X		
<i>Acacia</i>				X					
<i>Afzelia bella</i>							X		
<i>Allanblackia</i> spp.								X	
<i>Amaranthus caudatus</i>	X								
<i>Amaranthus esculentus</i>									X
<i>Amaranthus hypochondriacus</i>	X								
<i>Amygdalus</i>	X								
<i>Annona cherimola</i>	X								
<i>Annona muricata</i>		X					X		

Species name	Bioversity	CIAT	CIP	ICARDA	ICRISAT	IFPRI	IITA	ICRAF	WARDA
<i>Arracacia xanthorrhiza</i>			X						
<i>Artemisia cina</i>				X					
<i>Atriplex halymus</i>				X					
<i>Bactris gasipaes</i>		X							
<i>Benincasa hispida</i>	X								
<i>Berberis</i>				X					
<i>Blighia sapida</i>							X		
<i>Cajanus cajan</i>	X						X		
<i>Canavalia</i>		X							
<i>Canna indica</i>			X						
<i>Capsicum annum</i>									X
<i>Capsicum spp.</i>	X								
<i>Carthamus</i>				X					
<i>Carum carvi</i>				X					
<i>Cassia tora</i>	X								
<i>Cenchrus ciliaris</i>				X					
<i>Chenopodium pallidicaule</i>	X								
<i>Chenopodium quinoa</i>	X					X			
<i>Chrysophyllum albidum</i>							X		
<i>Citrus spp.</i>	X								
<i>Coix lacryma-jobi</i>	X								
<i>Crocus</i>				X					
Crop wild relatives	X								
<i>Cuminum cyminum</i>				X					
<i>Cydonia oblonga</i>				X					
<i>Cyperus esculentus</i>	X								
<i>Cyphomandra betacea</i>		X							
<i>Dialium guineense</i>							X		
<i>Dioscorea abyssinnica</i>							X		
<i>Dioscorea alata</i>							X		
<i>Dioscorea bulbifera</i>							X		
<i>Dioscorea cayenensis</i>							X		
<i>Dioscorea dumetorum</i>							X		
<i>Dioscorea esculenta</i>							X		
<i>Dioscorea hirtiflora</i>							X		
<i>Dioscorea mangelotiana</i>							X		
<i>Dioscorea praehensilis</i>							X		
<i>Dioscorea preusii</i>							X		
<i>Dioscorea rotundata</i>							X		
<i>Dioscorea togoensis</i>							X		
<i>Durio zibethinus</i>	X								
<i>Echinochloa frumentacea</i>	X								
<i>Elaeagnus</i>				X					
<i>Eleusine coracana</i>	X					X			
<i>Fagopyrum tataricum</i>	X								
<i>Ficus carica</i>	X								
Fodder species				X					
Food legume landrace and wild relatives				X					
Forest Berries	X								
<i>Garcinia mangostana</i>	X								
<i>Gliricidia sepium</i>							X		



Species name	Bioversity	CIAT	CIP	ICARDA	ICRISAT	IFPRI	IITA	ICRAF	WARDA
<i>Glycyrrhiza glabra</i>				X					
Grasses				X					
<i>Bactris gasipaes</i>		X							
<i>Haloxylon</i>				X					
<i>Hippophae rhamnoides</i>	X								
<i>Inga edulis</i>							X		
<i>Irvingia gabonensis</i>							X		
<i>Jatropha curcas</i>					X				
<i>Juglans</i>				X					
<i>Lathyrus</i> spp.	X								
<i>Lavandula</i>				X					
Leafy vegetables	X								
<i>Lepidium meyenii</i>			X						
<i>Leucaena</i>		X							
<i>Leucaena leucocephala</i>							X		
<i>Linum</i>				X					
<i>Mangifera indica</i>	X								
MAPs	X			X					
<i>Medicago sativa</i>				X					
<i>Mentha</i>				X					
<i>Millettia thonningii</i>							X		
<i>Mirabilis expansa</i>			X						
<i>Moringa oleifera</i>							X		
<i>Mucuna deeringiana</i>							X		
<i>Mucuna pruriens</i>							X		
<i>Nephelium lappaceum</i>	X								
<i>Ocimum</i>				X					
<i>Oxalis tuberosa</i>	X		X						
<i>Pachyrhizus ahipa</i>			X						
<i>Pachyrhizus erosus</i>			X						
<i>Pachyrhizus tuberosus</i>			X						
<i>Panax ginseng</i>	X								
<i>Panicum miliaceum</i>	X								
<i>Panicum sumatrense</i>	X					X			
<i>Panicum turgidum</i>				X					
<i>Parkia biglobosa</i>							X		
<i>Paspalum scrobiculatum</i>	X								
<i>Pennisetum americanum</i>							X		
<i>Pennisetum divisum</i>				X					
<i>Perilla frutescens</i>	X								
<i>Persea americana</i>							X		
<i>Phaseolus acutifolius</i>		X							
<i>Phaseolus lunatus</i>		X					X		
<i>Phaseolus polyanthus</i>		X							
<i>Pistacia</i>				X					
<i>Pistacia vera</i>	X								
<i>Pithecellobium dulce</i>							X		
<i>Pongamia pinnata</i>					X				
<i>Prosopis africana</i>							X		
<i>Prunus africana</i>								X	
<i>Prunus cerasifera</i>	X								

Species name	Bioversity	CIAT	CIP	ICARDA	ICRISAT	IFPRI	IITA	ICRAF	WARDA
<i>Prunus communis</i>	X								
<i>Prunus</i>				X					
<i>Psidium quajava</i>							X		
<i>Pterocarpus osun</i>							X		
<i>Punica granatum</i>	X			X					
<i>Quercus</i>				X					
<i>Rubus glaucus</i>		X							
<i>Salsola</i>				X					
<i>Salvia</i>				X					
<i>Sesamum indicum</i>	X						X		
<i>Sesamum</i>				X					
<i>Sesbania sesban</i>							X		
<i>Setaria italica</i>	X					X			
<i>Smallanthus sonchifolius</i>			X						
<i>Solanum aethiopicum</i>						X			
<i>Solanum melongena</i>									X
<i>Solanum quitoense</i>		X							
<i>Sphenostylis stenocarpa</i>							X		
<i>Spondias mombin</i>							X		
<i>Sterculia quadrifida</i>							X		
<i>Treculia africana</i>							X		
<i>Triticum dicoccon</i>	X								
<i>Tropaeolum tuberosum</i>			X						
<i>Ullucus tuberosus</i>	X		X						
<i>Vernonia amygdalina</i>							X		
<i>Vigna radiata</i>	X						X		
<i>Vigna subterranea</i>	X						X		
<i>Vigna umbrellata</i>	X						X		
<i>Vigna unguiculata</i>	X						X		
<i>Vigna vexillata</i>							X		
wheat wild relatives				X					
<i>Zingiber officinale</i>	X								
<i>Ziziphus jujuba</i>				X					

**Notes:**

- ICRAF works on many underutilized forest species (see Annex 5), but through the survey it only reported a project on one species.
- Bioversity's list of species reported here may not reflect full coverage, as Bioversity works by groups of species and through pilot species/case studies.

**Analysis: System Priorities addressed**

In the survey, the project managers of the CG centres were asked to evaluate the contribution of their projects/activities on underutilized species to relevant System Priorities, in particular System Priorities 1B, 2B, 3A, 4D, 5B and 5D (see Annex 4 and paragraph on System Priorities on page 6). Table 2 presents the information reported by the project coordinators on how each centre addresses the target System Priorities in their projects/activities related to underutilized plant species.

**Table 2: How the centres address the target System Priorities**

CG CENTRE MTP project Project/Activity	1b Conservation of UPGR	2b Tolerance to abiotic stresses	3a Increasing income	4d Sustainable ago-ecological intensification	5b International and domestic markets	5d Improving R&D options
BIOVERSITY	1b	2b	3a	4d	5b	5d
<b>Community Management of ABD</b> 1. Management of Seed Systems and GF 2. Empowering Sahelian farmers in crop diversity 3. <i>In-situ</i> conservation of ABD in Central Asia 4. Western Terai Landscape Complex 5. Home garden Nepal 6. Wild Tropical Fruit	Identification, characterization and selection of farmer-preferred traits of NUS that are used as staple crops; e.g. finger millet, taro, beans, etc.	Identification of useful traits adapted to stress tolerance in number of crops/varieties	Selection of productive temperate and tropical fruit tree species/varieties for improving access to germplasm and associated knowledge	Identification of diverse local crops that are drought tolerant	Research on value chain of tropical fruits and link to markets for income generation for poor farmers	Empowering community in accessing social, human and natural capital in order to overcome poverty traps
<b>ABD health and welfare</b> 1. ABD and nutrition 2. Agriculture and health in Burkina-Faso 3. ICUC-GFU-Bioversity 4. SGRP/GPG2 NUS 5. Assess food diets 6. Cons.- use of quinoa 7. VIR hort. spp.genebank 8. Forestry products 9. Training in nutrition 10. IFAD-NUS II Project 11. Training on NUS mrkt 12. Training on NUS value-addition in India 13. Training of facilitators 14. Hulled wheat mrkt 15. Mrkt of cherimoya 16. EU novel food regul. 17. Traditions in food value-Documentation 18. WorldFoodDay(NUS)	1. X  3. X 4. X 5. X 6. X 7. X 8. X 9. X 10. X 11. X 12. X  13. X  18. X	1. X  3. X 4. X	1. X 2. X  3. X 4. X 5. X  10. X 11. X 12. X  13. X	1. X  3. X 4. X 5. X 6. X  10. X 11. X 12. X  13. X 14. X 15. X 16. X 17. X	1. X  3. X 4. X	
<b>Conservation and management of ABD:</b> 1. Crop Wild Relatives  (Note: Many CWR form part of the genepool of the underutilized species, important to local communities)	Developing an effective and efficient strategy for their conservation <i>in situ</i> and also raising awareness of breeders so that the genetic resources can be characterized and used in breeding programs.					
<b>Facilitating use of GR:</b> 1. cherimoya production 2. water-use efficiency in almond 3. Variety Fig Catalogue 4. Microstallites (SRRs) for NUS 5. Molecular character. 6. Defin. core collections 7. Compilation of descriptors for NUS	Conservation, characterization and enhanced use of cherimoya diversity, understanding of diversity, optimization of <i>ex-situ</i> conservation	Better understanding of water-use efficiency based on characterization of root morphology	Market studies on underutilized fruits species, better cultivation practices		Improving cherimoya commercialization options	Reducing rural poverty
<b>International partnerships to use and conserve ABD:</b> 1. Global Facilitation Unit for Underutilized Species (GFU)	Promoting conservation and wider use of underutilized species, by raising awareness on this aim and working for	Facilitating work on the ability of underutilized species to deal with abiotic stresses e.g. climate	Promoting the value chain concepts to allow producers and small-scale processors to benefit from the commercialization of these crops.	Working for the conservation, promotion and use of underutilized species as a mean to diversify agricultural	Collaborating with partners to work towards an amendment of the EU Novel Food Regulation and hence towards better access to underutilized	Promoting higher investments in these crops (financial and non-financial) which demonstrate to have high potential in

	improved legal and policy-making environment to facilitate the work of the stakeholders in these areas	change	Collaborating with training institutions to provide the necessary skills for marketing of underutilized species	production, in particular in marginal conditions rendering low-potential areas economically interesting	species in EU markets	reducing poverty and vulnerability of communities and farming systems. Providing guidance to the research and development community on intervention areas
<b>Raising awareness to create support for ABD</b>		Raising awareness on underutilized species and translating it into greater appreciation and greater conservation and use				
<b>CIAT</b>	<b>1b</b>	<b>2b</b>	<b>3a</b>	<b>4d</b>	<b>5b</b>	<b>5d</b>
<b>Markets, Institutions and Livelihoods</b> 1. Enhancing competitiveness of smallholder growers of lulo and mora 2. Added-value lulo 3. Dynamics of sources of inocula and analysis of the anthracnose pathogen population	1.2.3.The germplasm will be available to end users with its respective information		1.2.3.The germplasm will be available to end users with its respective information			
<b>Conservation and use of tropical genetic resources</b> 1. Integrated Conservation of Neo-tropical Plant Genetic Resources	The germplasm will be available to end users with its respective information		The germplasm will be available to end users with its respective information			
<b>CIP</b>	<b>1b</b>	<b>2b</b>	<b>3a</b>	<b>4d</b>	<b>5b</b>	<b>5d</b>
<b>Genetic Resources Conservation and Characterization</b> 1. Conservation 2. Genetic characterization and evaluation	1.Repatriating healthy Andean tubers to restore biodiversity in communities where these genetic resources have been either reduced or lost; 2. Identifying promising material (yield, nutrition, and functional properties)	1. Providing promising material to users  2. Identifying promising material as a way to move forward	1. Developing strategies for integrated management of ART crops in traditional farming communities  2. Diffusing the functional properties of promising material	1. Distributing healthy material to users  2. Developing strategies for integrated crop management	1. Diffusing the main features of ART as functional foods  2. Developing Value-added products	1. 2. Alliances with national and international institutions
<b>ICARDA</b>	<b>1b</b>	<b>2b</b>	<b>3a</b>	<b>4d</b>	<b>5b</b>	<b>5d</b>
1.Saffron prod. /mrkt 2.Village decision 3.Mint cultivation 4.Better forage prod. 5.Afghanistan Agroenterprise 6.High value option 7.Natural ingredients 8.UPGR in crop rotation 9.MAPs in Morocco 10.High value crops in Balochistan Shrubs and grasses 12.Biotech development 13.Mrkt oriented feed prod 14.Women's Livelihoods Rural livelihoods 16.Productivity of salt-prone land 17.Fodder in Syria 18.MAPs mrkt chain 19.Horticultural mrkt chain 20.PGR use and exchange	9. X	12. X	2. X             20. X	1. X  3. X 4. X  6. X 7. X  10. X  13. X 14. X 15. X 16. X  17. X 18. X	1. X  3. X   7. X	

<b>ICRISAT</b>	<b>1b</b>	<b>2b</b>	<b>3a</b>	<b>4d</b>	<b>5b</b>	<b>5d</b>
<b>Reducing rural poverty through agric. divers. and high-value products</b> 1. Collection, germplasm evaluation, standard. of agro-techniques in Andhra Pradesh			X			
<b>IFPRI</b>	<b>1b</b>	<b>2b</b>	<b>3a</b>	<b>4d</b>	<b>5b</b>	<b>5d</b>
<b>Genetic resource policies for the poor: biodiversity and biotechnology policies</b> 1. Marketing underutilized species for the poor 2. Using markets to promote sustainable use of crop GR	1. Indirectly: identifying and analysing institutional mechanisms for the use of underutilized species; the conceptual framework helps distinguish species for conservation/ market development		1. Indirectly (in specific case studies)		1. Focus on market constraints and development; it identifies constraints and potential solutions to increase market access and efficiency of markets for small holders, while promoting diversification. It addresses needs for supply control mechanisms to facilitate product differentiation	
<b>IITA</b>	<b>1b</b>	<b>2b</b>	<b>3a</b>	<b>4d</b>	<b>5b</b>	<b>5d</b>
<b>Root and Tuber Systems</b>		X		X	X	X
<b>Agrobiodiversity</b> 1. Characterization, documentation, sanitation, regeneration of cowpea relative and other under-used species	Addressing the maintenance, characterization and document. of underutilized species.					
<b>ICRAF</b>	<b>1b</b>	<b>2b</b>	<b>3a</b>	<b>4d</b>	<b>5b</b>	<b>5d</b>
<b>Tree Domestication and management of tree genetic resources</b> Allanblackia: A new tree crop for Africa	Promoting on-farm planting, contributing to natural habitats and knowledge on Allanblackia	Selecting for better, more productive genotypes	Working with private sector (Unilever), committed to buying Allanblackia oil from small holder	On-farm planting of this forest tree contributes to forest management	Making the link with private sector that has interest in buying the oil (Unilever and other companies)	Advancing the work on policies
<b>Tree product market</b>			X			
<b>WARDA</b>	<b>1b</b>	<b>2b</b>	<b>3a</b>	<b>4d</b>	<b>5b</b>	<b>5d</b>
<b>Integrated Rice Production Systems</b> 1. Performance of Irrigated Rice-based Systems in Africa 2. Intensification of Lowland Rice-based Systems	Collecting, storing, evaluation and characterization of landraces of these vegetables		Reducing rural poverty through rice-based diversification and emerging opportunities for high-valued vegetables			

The following table summarizes the outcome of the survey on the System Priorities. The crosses highlighted in bold mean that the centre's projects address those priorities in particular, compared to the others. As shown in Table 3, the System Priorities mainly targeted by the projects and activities carried out by the CG centres are 1B and 3A, followed by 5B and then by 2B, 4D and finally 5D.

**Table 3: System Priorities addressed by CG centres in their projects/activities on underutilized species**

Centre	1B	2B	3A	4D	5B	5D
Biodiversity	X	X	X	X	X	X
CIAT	X		X			
CIP	X	X	X	X	X	X
ICARDA	X	X	X	X	X	
ICRISAT			X			
IFPRI	X		X		X	
IITA	X	X		X	X	
World Agrofore Centre ICRAF	X	X	X	X	X	X
WARDA	X		X			

### ***Analysis: Research gaps identified by the CG centres***

The main research gaps identified by the CG centres carrying out projects on underutilized plant species to achieve the target priorities are summarized as a lack of research work on the following issues relating to these species:

#### *Production, consumption and market*

- ✓ consumer preferences on existing species diversity
- ✓ market constraints and market development
- ✓ development of new products, value-addition, processing
- ✓ the role of producers' organization in conservation and development of underutilized species
- ✓ promotion and consumption impact on the conservation and sustainable use of these species
- ✓ indigenous knowledge documentation system
- ✓ the effect of removing trade barriers for underutilized species

#### *Characterization of genetic and agronomic traits*

- ✓ evidence and data on the nutritional value
- ✓ characterization of existing genetic variability
- ✓ ecology distribution and threats
- ✓ identification of resilient and resistant species
- ✓ breeding
- ✓ production system technologies
- ✓ development of biotechnology tools

#### *Conservation and sustainable use*

- ✓ germplasm collections
- ✓ traditional storage systems

In addition to the technical research gaps mentioned above, there were a number of strategic issues raised by the CG centre coordinators who participated in the survey, which can be considered as possible recommendations for strategic areas for CG research in the field of underutilized plant species. These topics are related to i) the identification and proper use of indigenous knowledge on the utilization, production and processing of underutilized species and the need to develop a systematic indigenous knowledge documentation system; ii) the formation of farmers' and producers' groups to enhance the production and marketing of products derived from underutilized species to increase their income generation; iii) the identification of market information that would help improve the demand/supply system of these products; iv) the integrated farming systems and on-farm diversification of species; v) the management of invasive species; vi) the promotion of dietary diversity where the underutilized species have an important role to play, for their nutritional content and their availability and affordability to local communities in developing and transitioning countries, as for the increasing interest by marketing novel food in industrialized countries; vii) the

removal of barriers in the acquisition of new germplasm; and viii) the removal of trade barriers for underutilized species and derived products.

The research gaps and strategic areas identified above have been reported by more than one centre. The following cross-table (Table 4) shows the commonalities shared by a number of CG centres.

**Table 4: Research gaps reported by CG centres**

Research Gaps	Bioversity	CIAT	CIP	ICARDA	IFPRI	ICRISA T	IITA	ICRAF	WARDA
Consumer preferences on existing species diversity	X								
Market constraints and market development	X				X				
Development of new products, value-addition, processing	X		X						
The role of producers' organization in conservation and development of underutilized species	X	X							
Promotion and consumption impact on the conservation and sustainable use of these species							X		
Characterization of genetic variability	X	X	X	X		X	X		X
Evidence and data on the nutritional value	X	X				X	X		
Ecology distribution and threats	X					X			
Identification of resilient and resistant species		X					X		
Breeding practices		X							
Production system technologies		X							
Germplasm collections and traditional storage systems		X	X	X					
<b>Other needs</b>									
Documentation of information	X								X
Development of a systematic indigenous knowledge documentation system	X		X						
Promotion of dietary diversity (including underutilized species)	X						X		
Removal of trade barriers	X								
Removal of barriers in acquisition of new germplasm		X							

### ***Analysis: Comparative advantages of the centres***

The project managers gave emphasis to the comparative advantages of their centres in conducting the activities on underutilized species over other centres and other stakeholders.

Some organizations, such as CIP, IITA, ICRISAT and WARDA have the comparative advantage of being located in the centre of origin of the species they are working on, so they can work in close collaboration with the communities managing those species and owning the traditional knowledge, and they have the long-established experience in working with that species together with local and international institutions. Other centres claim to have in-house specialists that can manage research on germplasm, breeding, biotechnology, as at CIAT and ICARDA; database management, characterization and evaluation of plants, as at WARDA; applied economics and policy analysis, as at IFPRI; or sustainable use and promotion, as at Bioversity. Other centres, such as CIAT, CIP, IITA, WARDA, ICARDA own germplasm collections and facilities to carry out diversity studies; while others, such as ICRAF and CIP, have experience in the domestication of species and public-private collaborations for market development. Finally, some centres, such as Bioversity, IFPRI and CIAT, feel that they have a solid image as an honest broker/networking institute. Bioversity claims to have a coordinating role and global mandate on biodiversity-sustainable conservation and use and the relevant experience and recognized profile in the field of underutilized plant species and the dissemination of the results. Table 5 shows a synthesis of the results.

**Table 5: Comparative advantages of the centres**

Centre	Location near	In-house	Germplasm	Honest	Coordination,	Domestication,
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	species origin	specialists	collection and facilities	broker/networking	global mandate/profile	market development
Bioversity		X		X	X	
CIAT		X	X	X		
CIP	X	X	X			X
ICARDA		X	X			
ICRISAT	X					
IFPRI		X		X		
IITA	X		X			
ICRAF						X
WARDA	X	X	X			

## Discussion on the underutilized plant species list

Most of the species reported by the centres in the survey on the CG projects dealing with underutilized species are included in the list drafted by GFU (see Annex 3). Some project managers have commented on the GFU list about the inclusion or exclusion of some species and made their suggestions in the following way.

1. The following species should be added to the list:

- ✓ *Rubus glaucus*
- ✓ *Lablab purpureus*
- ✓ *Dioscorea abyssinica*
- ✓ *Dioscorea mangelotiana*
- ✓ *Dioscorea praehensilis*
- ✓ *Dioscorea togoensis*
- ✓ *Averrhoa carambola*
- ✓ *Caryodendron orinocense*
- ✓ *Caryodendron amazonicum*
- ✓ *Plukenetia volubilis*
- ✓ *Spondias tuberosa*
- ✓ *Syzygium jambos*
- ✓ *Canna indica*

2. The following species should be removed from the list, because they are not considered underutilized:

- *Arachis pintoi*,
- *Cratylia argentea*

These two forage legumes have changed status from completely unknown, a few years ago, to best-sellers on the forage-seed markets (in Central America), so they should not be considered underutilized species.

- *Carica papaya*
- *Mangifera indica*
- *Persea americana*
- *Passiflora manicata*

Papaya and mango should not be considered underutilized species, since, along with banana, pineapple and avocado, they account for over 90 % of fruit exports. *Passiflora manicata* should be removed from the list, as this species is toxic. It has possible uses as a medicinal or ornamental plant or as a source for resistance genes.

- *Acacia mangium*
- *Prunus africana*

*Prunus africana* is over-utilized and at risk of extinction in several places.



- *Acacia mearnsii*
- *Chromolaena odorata*

These species have been nominated as being among the "World's Worst" invaders

- *Argania spinosa*
- *Tamarindus indica*
- *Gnetum* spp.

The above species are widely used by local people and have access to local, regional and international markets.

- Azuki bean

It is repeated as *Phaseolus angularis* (an old name) and as *Vigna angularis* (correct and currently valid name).

## Summary and Conclusions

From the revision of the CG centres' MTPs and from the result of a survey involving more than 30 project managers (with feedback from 71%) conducting activities related to underutilized plant species in the CG centres, it resulted that 9 centres out of the 15 (60% total) work on projects or activities involving underutilized species, and one centre (CIMMYT) is in the initial phases of developing some activities and IRRI works on wild relatives of rice. The centres carrying out activities on underutilized species are Bioversity International, CIAT, CIP, ICARDA, ICRISAT, IFPRI, IITA, World Agroforestry Centre (ICRAF) and WARDA. Some centres have extensive projects and activities related to a great number of underutilized species, others have minor activities embedded within bigger projects. All the above centres also report the projects at MTP level. However, details on sub-projects and activities have been obtained through the information provided by the project managers contacted during the survey.

The remaining 4 centres, namely CIFOR, ILRI, IWMI and World Fish, are not currently working on projects related to underutilized plant species. IWMI hosts the International Center for Underutilized Crops (ICUC) within a partnership of mutual cooperation.

The survey highlighted the contribution of the projects/activities on underutilized species carried out at the CG centres participating in target System Priorities 1B, 2B, 3A, 4D, 5B and 5D. The results show that the projects/activities address mainly System Priorities 1B (Promoting conservation and characterization of underutilized plant genetic resources) and 3A (Increasing income from fruit and vegetables). Secondly, System Priorities 5B (Making international and domestic markets work for the poor), 2B (Improving tolerance to selected abiotic stresses) and 4D (Promoting sustainable agro-ecological intensification in low- and high-potential areas) are equally tackled. The least targeted System Priority is 5D (Improving research and development options to reduce rural poverty and vulnerability).

The main research gaps in achieving the target priorities identified in the survey by the CG centres carrying out projects on underutilized plant species were the lack of research and, therefore, the need for further work on issues related to *Production, consumption and market; Characterization of genetic and agronomic traits and Conservation and sustainable use*. In particular, the lacunae that have been identified by more than one centre were: i) the research on the production, processing, value-addition, commercialization and trade of the underutilized species; ii) information related to the consumers' preferences, marketing, and nutritional values, iii) research and data on the genetic diversity, ecology distribution, resilient and resistant species, breeding and production system technologies, and iv) germplasm collection and traditional storage systems. Besides these technical

research gaps, there were a number of strategic issues raised by the CG centres during the survey, which can be considered as possible recommendations for strategic areas for CG research in the field of underutilized plant species. Some of these areas, among others are i) the identification and proper use of indigenous knowledge and the development of a systematic indigenous knowledge documentation system; ii) the importance of farmers' and producers' groups to enhance production and marketing; iii) the identification of market information; iv) the integrated farming systems and on-farm diversification of species; v) the promotion of dietary diversity in which the underutilized species have an important role to play.

In the survey, the project managers emphasized the comparative advantages of their centres in conducting the activities over other centres and other stakeholders. A comparative advantage shared by some organizations relates to the fact that the centres are placed in the centre of origin of the species they are working on, so they can work in close collaboration with the communities managing those species, and they have long-established experience in working with that species together with local and international institutions. Other centres claim to have in-house specialists that can manage research on germplasm, breeding, biotechnology, applied economics and policy analysis. Other centres own germplasm collections and facilities to carry out diversity studies. Finally, some centres have a relevant experience and a recognized profile in the field of underutilized plant species and a solid image as an honest broker/networking institute.

A number of underutilized plant species are addressed by projects and activities carried out by CG centres. Nevertheless, the research efforts on these species are still lacking and there are still many species to be studied. Even though more than one centre is working on the same species, there is no overlap, given that the centres address different research aspects. Most of the species on which the centres are working in their projects on underutilized species reported in the survey are included in the list drafted by GFU. Nevertheless, some project managers would like to see the GFU list modified, including some more identified species and removing some species that they think they are not underutilized for a given reason. With regard to this, they made clear indication of the species to be included and removed.

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Jaenicke, H. and Höschle-Zeledon, I. (eds) 2006. Strategic Framework for Underutilized Plant Species Research and Development, with Special Reference to Asia and the Pacific, and to Sub-Saharan Africa. International Centre for Underutilised Crops, Colombo, Sri Lanka and Global Facilitation Unit for Underutilized Species, Rome, Italy. 33 pp.

Medium Term Plans (2007-2009) of the following CG centres: Bioversity, CIAT, CIP, ICARDA, ICRISAT, IFPRI, IITA, ICRAF, WARDA.

## Annex 1: Synthesis table with projects and project managers

Table 6: Synthesis of projects, activities and project managers at CG centres

CG Centre	Title of MTP project (title of project/programme reported at MTP level): Title of Project or Activity (falling under the MTP project)	Activities (types of activities carried out in the Project/Activity on the left column)	Project coordinator(s)
BIOVERSITY	<b>Community Management of Agricultural Biodiversity:</b> Adaptive Management of Seed Systems and Gene Flow (Mexico, Cuba and Peru)	Diversity assessment for useful and economic traits	Bhuwon Staphit <a href="mailto:b.staphit@cgiar.org">b.staphit@cgiar.org</a>
	Programme for Empowering Sahelian Farmers to Leverage Their Crop Diversity Assets for Enhanced Livelihood Strategies	Improving access to germplasm and knowledge	
	<i>In-situ</i> Conservation of Agricultural Biodiversity (Horticultural Crops and Wild Fruit Species) in Central Asia Phase II - Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan. (Sub-Programme Biodiversity -13: Agriculture)	Value addition and market links	
	Western Terai Landscape Complex (WTLCP)(Nepal) implemented by NGO partner	Community-based crop improvement	
	Home garden project in Nepal implemented by NGO partner		
	Conservation and Sustainable Use of Cultivated and Wild Tropical Fruit Diversity: Promoting Sustainable Livelihoods, Food Security and Ecosystem Services (India, Indonesia, Malaysia, Thailand)		
	<b>Agricultural Biodiversity, Human Health and Welfare:</b> Development of international cross-cutting initiative on agricultural biodiversity and nutrition	Sensitizing policy and decision makers	Stefano Padulosi <a href="mailto:s.padulosi@cgiar.org">s.padulosi@cgiar.org</a>
	Workshop in Burkina Faso on Agriculture and Health	Bridging gap between Agriculture and Health sector	
	Global ICUC-GFU-Bioiversity strategy on underutilized species	Developing strategic framework on underutilized species	
	SGRP/GPG2 NUS	Assessing the status of conservation/needs of NUS in CGIAR genebanks	
	Assess food diets (and indirectly nutritional status) and healthful components in selected countries/ areas	Developing food diet surveys (Malawi, Mozambique, Peru, Bolivia, India)	
	Study on current status of conservation and use of quinoa in Uyuni, Bolivia	Policy recommendations for enhancing use of crop	
	Nutritional characterization of VIR hort. spp. gene bank material	Enhancing the use of conserved forest berries genetic resources in gene bank	
	Forest diversity and health compendium of nutrition and healthy function of forestry products	Documentation on nutritional contribution of these products	
	Training of West African scientists in nutrition analysis and food composition research	Enhancing human capacity	
	IFAD-NUS II Project (including the scaling-up of IFAD-NUS I)	Enhancing production/value adding for millet and Andean grains; training activities on marketing in Yemen, India, Bolivia and Peru; contributeingto improving regulatory market frameworks; ecotourism promotion to enhance NUS, income generation and nutrition	
	Organization of a training course in Wageningen on marketing NUS	Capacity building	
	Organization of a training course on value addition, marketing minor millets/NUS in India	Capacity building	
	Training of facilitators at AVRDC in integrated agricultural research for vegetable/NUS production, utilization and marketing, environmental protection, accountability, gender and participatory approaches	Capacity building	
	Analyses of market and value chain of hulled wheat in Turkey and Italy	Market study	
Study on commercialization and processing of cherimoya in Ecuador, Peru and Bolivia	Enhancing commercialization		
Provide scientific assistance to UNCTAD for the elaboration of safety dossiers of foods subject to EU novel food regulations	Contributing to improving regulatory market frameworks		

	Use practices for African leafy vegetables/NUS documented and value of food traditions identified, recorded and publicized	Document knowledge, raising awareness, promoting greater use of target species	
	Celebration of World Food Day	Raising public awareness about NUS	
	<b>Conservation and Management of Agricultural Biodiversity:</b> <i>In-situ</i> Conservation of Crop Wild Relatives through Enhanced Information Management and Field Application	Increase knowledge of the conservation status of CWR; link global informational systems to national ones; developing a procedure to analyse and identify needed conservation actions for CWR	Ehsan Dulloo, <a href="mailto:E.Dulloo@cgiar.org">E.Dulloo@cgiar.org</a>
	<b>Facilitating use of genetic resources:</b> Promotion of sustainable cherimoya production systems in Latin America through the characterization, conservation and use of local germplasm diversity	Conservation ( <i>ex situ</i> and <i>in situ</i> ); diversity studies; improved use (good agricultural practices, commercialization).	Xavier Scheldeman <a href="mailto:x.scheldeman@cgiar.org">x.scheldeman@cgiar.org</a>
	Characterization of water-use efficiency in almond	Studies of water-use characteristics and root morphology	
	Variety Fig ( <i>Ficus Carica</i> ) catalogue	Documentation	
	Development of microstallites (SRRs) for Capsicum spp., amaranthus, tartary buckwheat, Citrus spp., ginger, ginseng, mung bean, Perilla frutescens and sesame	SSR markers for underutilized species	
	Molecular characterization of ginger, Job's tears and Perilla frutescens	Understanding species diversity	
	Definition of core collections tartary buckwheat, finger millet, foxtail millet, proso millet, kodo millet, little millet and barnyard millet	Enhancing the conservation of underutilized species through identification of core collections	
	Compilation of descriptors on Cherimoya, Durio zibethinus, Lathyrus, Oxalis and Ullucus	Documentation of species variety	Adriana Alercia <a href="mailto:a.alercia@cgiar.org">a.alercia@cgiar.org</a>
	<b>Mobilizing International Partnerships to Use and Conserve Agricultural Biodiversity:</b> Global Facilitation Unit for Underutilized Species (GFU)	Analysis of policies; policy recommendations to create favourable legal and policy environments for underutilized species; providing information on projects, experts, institutions, species, funding opportunities, training and other events; organization of events on underutilized species; awareness raising at different levels on the importance of underutilized species for livelihoods improvement.	Irmgard Hoeschle-Zeledon <a href="mailto:i.zeledon@cgiar.org">i.zeledon@cgiar.org</a>
	<b>Raising Awareness to Create Support for Agricultural Biodiversity</b>	Development of public awareness material	Ruth Raymond <a href="mailto:r.Raymond@cgiar.org">r.Raymond@cgiar.org</a>
CIAT	<b>Markets, Institutions and Livelihoods:</b> Enhancing competitiveness of smallholder growers of lulo and mora through participatory selection of elite clones, integrated crop management and strengthening of value chains  Added-value lulo: alternatives for smallholder producers  Dynamics of sources of inocula and analysis of the anthracnose pathogen population infecting tropical fruits	Improving germplasm, crop management, access to markets and propagation technologies for rural communities for lulo and mora. Starch quality attributes of populations of peach palm, disease resistance and management of anthracnose in soursoap and tree tomato, as well as genetic variability. Linking smallholder producers to markets, supply chain information and boosting high value of various crops	Alonso Gonzalez <a href="mailto:a.gonzalez@cgiar.org">a.gonzalez@cgiar.org</a>
	<b>Conservation and use of tropical genetic resources:</b> Integrated Conservation of Neo-tropical Plant Genetic Resources	Multiplication, characterization, conservation and distribution of seed accessions, a better understanding of diversity in conserved collections, and information on how to increase the collections with novel genetic diversity	Daniel Debouck <a href="mailto:d.debouck@cgiar.org">d.debouck@cgiar.org</a>
CIP	<b>Genetic Resources Conservation and Characterization:</b> Conservation	Collection of wild and cultivated genetic resources of Andean roots and tubers and associated information; conservation of the material through integrated <i>ex-situ</i> , <i>in-situ</i> , and on-farm approaches; dissemination of material to end users	Carlos Arbizu <a href="mailto:c.arbizu@cgiar.org">c.arbizu@cgiar.org</a> David Tay <a href="mailto:d.tay@cgiar.org">d.tay@cgiar.org</a>

	Genetic characterization and evaluation	Morphological and molecular characterization, and evaluation of Wild and cultivated genetic resources of Andean roots and tubers	
ICARDA	'Research in production and marketing of saffron as an alternative to opium poppy cultivation'	Production, processing, marketing	Ken Street <a href="mailto:K.Street@cgiar.org">K.Street@cgiar.org</a>
	'Village Decision Driven Research Project' ( <i>Prunus, Quercus, Juglans</i> )	Capacity building of the Ministry of Agriculture	
	'Cultivation of mint as a viable alternative livelihood in East and North East of Afghanistan' ( <i>Mentha</i> and <i>Ocimum</i> )	Production, processing, marketing	
	'Improved rural incomes from better forage production and sales of milk products' (forage crops: <i>Medicago, Avena, Lathyrus</i> )	Enhancing use of rainfed and irrigated arable land for sustainable production of improved agronomy practices	
	'Western Afghanistan Agroenterprise Action Research Program'	high-value crop production, marketing opportunities and small-scale value-adding activities	
	'Increased Productivity and Profitability of Wheat-based Cropping Systems to Reduce Reliance on Opium Poppy in Northern Afghanistan' ( <i>Sesamum, Carthamus, Linum</i> )	Developing new high value livelihood options	
	'Multi-Stakeholder Programme on Natural Ingredients for Food, Pharmaceuticals and Cosmetics in Afghanistan' ( <i>Glycyrrhiza, Carum, Artemisia, Ziziphus jujuba</i> )	Developing natural products coming from wild-collected plants, improving knowledge of and access to processing technologies, to improve quality and market access	
	'Enabling communities in the Aral Sea basin to combat land and water resource degradation through the creation of 'bright' spots' ( <i>Ziziphus jujuba, Medicago sativa</i> )	Improving technology to enhance the productivity, introducing crop rotation	
	'Biological Diversity, Cultural and Economic Value of Medicinal, Herbal and Aromatic Plants in Morocco' ( <i>Lavandula, Salvia, Crocus, Ocimum</i> )	Economics and marketing studies	
	'Applied research component of "Food Security/Poverty Alleviation in Arid Agriculture Balochistan - Pilot Project Phase" (pistachio and pomegranate, <i>Berberis, Prunus, Panicum, cumin</i> );	Evaluation of germplasm and management options; introduction of germplasm with drought tolerance and with high market quality	
	'Appropriate methods of restoration ecology and specifically trials for the successful establishment of the key forage species "shrubs and grasses" for degraded sites' ( <i>Salsola, Haloxylon, Atriplex, Cenchrus ciliaris, Panicum turgidum and Pennisetum divisum</i> )	Improving rangeland management and promoting intensive rehabilitation	
	'Biotechnology development in Arab World' (wheat wild relatives)	Improving NARS capacity building in functional analysis	
	'Community Action in Integrated and Market Oriented Feed-Livestock Production in Central and South Asia' (fodder species)	Community-based actions to support production, access to market and sustainable management of the natural resources	
	'Rehabilitation of Agricultural Livelihoods of Women in Marginal Post-Conflict Areas of Afghanistan and Pakistan' ( <i>Ziziphus, Medicago, Acacia, Atriplex</i> )	Capacity building of women to cope with shock with use, cultivation, processing and marketing	
'Improving Rural Livelihoods through Efficient On-Farm Water and Soil Fertility Management in Central Asia' ( <i>Cydonia, Ziziphus, Elaeagnus -oleaster</i> )	Adoption by farmers of technological and institutional innovations that conserve soil and water, are sustainable and input-use efficient		
'Enhancing the productivity of salt-prone land and water resources to ensure sustainability of smallholder crop-livestock farmers in West and Central Asia' (food-feed crops, grasses, fodders and forage legumes)	Developing biophysical interventions and promoting institutional and policy options for sustainable and integrated use of saline water and salt-affected soils		

	'Enhancing Livelihoods of Poor Livestock Keepers through Increased Use of Fodder in Syria' (fodder)	Capacity building for poor livestock keepers to select and adopt fodder options and access market opportunities	
	'Commodity Chain Analysis for Selected MAPs in NENA Region'	Commodity chain analysis	
	'Commodity chain analysis for selected horticultural exports in the NENA region' ( <i>Prunus</i> , <i>Pistacia</i> in Morocco)	Commodity chain analysis	
	'Genetic Resource Conservation, Documentation and Utilization in Central Asia and the Caucasus' (food legume landrace and wild relatives)	Development of long-term regional capacity to collect, conserve, document, utilize and exchange PGR and of PGR information system	
<b>ICRISAT</b>	<b>Reducing Rural poverty through agricultural diversification and emerging opportunities for high-value commodities and products</b> 'Collection, Evaluation of Germplasm, Standardization of Agro-techniques and Pilot demonstration for <i>Jatropha curcas</i> L. in Rain Shadow Districts of Andhra Pradesh'.	Evaluation of <i>Jatropha</i> germplasm in nursery and main plantations; standardization of agro-techniques.	SP Wani, <a href="mailto:S.Wani@cgiar.org">S.Wani@cgiar.org</a>
<b>IFPRI</b>	<b>Genetic Resource Policies for the Poor: Biodiversity and Biotechnology Policies:</b> Marketing underutilized species for the poor	Development of a conceptual framework, conduction of case studies on necessary conditions for successful commercialization of some underutilized plant species and synthesis and policy guidelines	Melinda Smale <a href="mailto:m.smale@cgiar.org">m.smale@cgiar.org</a> Guillaume Gruere <a href="mailto:g.gruere@cgiar.org">g.gruere@cgiar.org</a>
	Using markets to promote the sustainable utilization of crop genetic resources	Development of project concepts, methodology for the seed systems work on minor millets, study sites selection and sampling framework, field implementation schedule, implementation of markets and household surveys, conduction of market and household seed diversity studies, morphological characterization through grow-outs for Kolli Hills and Dharmapuri Plains.	
<b>IITA</b>	<b>Root and Tuber Systems</b>	Identification of high food quality sources and functional characteristics in yams; marketing channels and market efficiency; identification of biological control to restrain tuber rot; preparation of business plans for setting up small-to-medium scale seed production; assessment of the effects of trade and market liberalization on technology adoption to increase productivity; production of interspecific hybrids (in yams species)	Robert Asiedu <a href="mailto:R.asiedu@cgiar.org">R.asiedu@cgiar.org</a>
	<b>Agrobiodiversity</b> Characterization, documentation, sanitation, regeneration of cowpea relative and other under-used species	Identification, morphological characterization, passport data, sanitation and regeneration of bambara ground nut and green gram; seed storage, monitoring and arboretum maintenance of various underutilized species; reproductive biology and genetic diversity study of African yam beans, <i>In-situ</i> conservation, field conservation and <i>in vitro</i> duplication of Dioscorea germplasm.	David Chikoye <a href="mailto:d.chikoye@cgiar.org">d.chikoye@cgiar.org</a> .
<b>World Agroforestry Centre (ICRAF)</b>	<b>Tree Domestication and management of tree genetic resources</b> Allanblackia: A new tree crop for Africa	Development of germination protocols and of best approaches for different aspects of Allanblackia's value chain, from domestication, on-farm planting to collection and then processing of oil for collection of 6 Allanblackia species. Molecular work to ensure high productivity, geneflow, genetic diversity, genebanks	Ramni Jamnadass <a href="mailto:r.jamnadass@cgiar.org">r.jamnadass@cgiar.org</a>
	<b>Tree product market</b>	Markets for agroforestry tree products, quality characterization of tree products across their geographical ranges (e.g., shea butter in West Africa); research on agroforestry enterprise in tree nurseries, tree growing/harvesting, and marketing. Developing maps for indigenous trees for communities farms for timber, fruit, watershed protection, biodiversity and other services (on 300 forest species)	
<b>WARDA</b>	<b>Integrated Rice Production Systems</b> Enhancing the Performance of Irrigated Rice-based Systems in Africa	New high-value vegetable or field crop options to fit a rice-based system	Ines Sanchez <a href="mailto:i.sanchez@cgiar.org">i.sanchez@cgiar.org</a>
	Sustainable Intensification of Lowland Rice-based Systems for Enhanced Livelihoods	Intensification and diversification opportunities, including rice and rice-vegetable integration	

	New project research (not yet funded) : Valorization of underutilized indigenous vegetables grown in West African lowland rice systems	Paul Kiepe <a href="mailto:pkiepe@cgiar.org">pkiepe@cgiar.org</a>
<b>CIMMYT</b>	<b>No projects on underutilized plant species at this time</b> Work on markets for differentiated (de-commodified) maize products (e.g. markets for particular landraces) is at an initial phase	(contact) Jonathan Hellin <a href="mailto:j.hellin@cgiar.org">j.hellin@cgiar.org</a>
<b>IRRI</b>	<b>No projects on underutilized plant species reported through the survey</b> Work on wild relatives of rice and <i>Azolla</i> spp. (mosquito fern)	(contact) Ruaraidh Sackville Hamilton <a href="mailto:R.Hamilton@cgiar.org">R.Hamilton@cgiar.org</a>
<b>CIFOR</b>	<b>No Projects on underutilized plant species</b>	
<b>ILRI</b>	<b>No Projects on underutilized plant species</b>	
<b>IWMI</b>	<b>No Projects on underutilized plant species</b> Hosting The International Center for Underutilized Crops (ICUC) within a partnership of mutual cooperation	
<b>World Fish</b>	<b>No Projects on underutilized plant species</b>	

## Annex 2: Questionnaire used for the survey

### QUESTIONNAIRE ABOUT THE PROJECTS/ACTIVITIES ON UNDERUTILIZED PLANT SPECIES AT CG CENTRES

We would be very grateful if you could kindly reply to the following questions to complete a strategic analysis of CGIAR current and planned activities on underutilized plant species commissioned by SGRP-GPG 2.

1. Title of the Project/Programme (MTP level), which includes activities on underutilized plant species:

2. Title of the <b>specific project/activity</b> dealing with underutilized species

3. Brief description of the specific project activities	List of the underutilized species addressed by the activities	
	Vernacular name (English)	Scientific name

4. Main outputs of this specific project

5. Please describe how this specific project contributes to the following System Priorities:	
1B	
2B	
3A	
4D	
5B	
5D	

6. Can you identify any existing research gaps in the project to fully address the corresponding System Priority/Priorities?

7. What do you think are the comparative advantages of your Center to carry out this project on underutilized species over other Centers and institutions?

THANK YOU VERY MUCH FOR YOUR KIND COOPERATION!



## Annex 3: GFU list of underutilized plant species

(Source [www.underutilized-species.org](http://www.underutilized-species.org), accessed on 10 November 2007)

Genus	Species		
<i>Abelmoschus</i>	<i>caillei</i>	<i>Aloe</i>	<i>boylei</i>
<i>Abelmoschus</i>	<i>esculentus</i>	<i>Aloe</i>	<i>ferox</i>
<i>Abies</i>	<i>amabilis</i>	<i>Aloe</i>	<i>polyphylla</i>
<i>Abies</i>	<i>balsamea</i>	<i>Aloe</i>	<i>vera</i>
<i>Abies</i>	<i>cephalonica</i>	<i>Amaranthus</i>	<i>caudatus</i>
<i>Abies</i>	<i>concolor</i>	<i>Amaranthus</i>	<i>cruentus</i>
<i>Abies</i>	<i>fraseri</i>	<i>Amaranthus</i>	<i>dubius</i>
<i>Abies</i>	<i>lasiocarpa</i>	<i>Amaranthus</i>	<i>gracisane</i>
<i>Acacia</i>	<i>auriculiformis</i>	<i>Amaranthus</i>	<i>hybridus</i>
<i>Acacia</i>	<i>boliviana</i>	<i>Amaranthus</i>	<i>hypochondriacus</i>
<i>Acacia</i>	<i>colei</i>	<i>Amaranthus</i>	<i>lividus</i>
<i>Acacia</i>	<i>hemiteles</i>	<i>Amaranthus</i>	<i>palmeri</i>
<i>Acacia</i>	<i>jacquemontii</i>	<i>Amaranthus</i>	<i>paniculatus</i>
<i>Acacia</i>	<i>karroo</i>	<i>Amaranthus</i>	<i>retroflexus</i>
<i>Acacia</i>	<i>leucophloea</i>	<i>Amaranthus</i>	<i>spinosus</i>
<i>Acacia</i>	<i>mangium</i>	<i>Amaranthus</i>	<i>tricolor</i>
<i>Acacia</i>	<i>mearnsii</i>	<i>Amaranthus</i>	<i>viridis</i>
<i>Acacia</i>	<i>prainii</i>	<i>Ambelania</i>	<i>acida</i>
<i>Acacia</i>	<i>subrigida</i>	<i>Ambelania</i>	<i>sagotii</i>
<i>Acacia</i>	<i>tortilis</i>	<i>Amelanchier</i>	<i>pallida</i>
<i>Acacia</i>	<i>villosa</i>	<i>Amorphophallus</i>	<i>campanulatus</i>
<i>Acca</i>	<i>sellowiana</i>	<i>Anacardium</i>	<i>occidentale</i>
<i>Achras</i>	<i>sapota</i>	<i>Annona</i>	<i>cherimola</i>
<i>Acorus</i>	<i>calamus</i>	<i>Annona</i>	<i>diversifolia</i>
<i>Acrocomia</i>	<i>aculeata</i>	<i>Annona</i>	<i>montana</i>
<i>Acrocomia</i>	<i>totai</i>	<i>Annona</i>	<i>muricata</i>
<i>Adansonia</i>	<i>digitata</i>	<i>Annona</i>	<i>reticulata</i>
<i>Adansonia</i>	<i>grandidieri</i>	<i>Annona</i>	<i>squamosa</i>
<i>Aegle</i>	<i>marmelos</i>	<i>Arbutus</i>	<i>unedo</i>
<i>Afzelia</i>	<i>bella</i>	<i>Argania</i>	<i>spinosa</i>
<i>Aiphanes</i>	<i>aculeata</i>	<i>Arnica</i>	<i>montana</i>
<i>Allanblackia</i>	<i>floribunda</i>	<i>Aronia</i>	<i>alnifolia</i>
<i>Allanblackia</i>	<i>gabonensis</i>	<i>Arracacia</i>	<i>xanthorrhiza</i>
<i>Allanblackia</i>	<i>kimbiliensis</i>	<i>Artemisia</i>	<i>absinthium</i>
<i>Allanblackia</i>	<i>kisonghi</i>	<i>Artemisia</i>	<i>afra</i>
<i>Allanblackia</i>	<i>marienii</i>	<i>Artemisia</i>	<i>annua</i>
<i>Allanblackia</i>	<i>parviflora</i>	<i>Artemisia</i>	<i>arbuscula</i>
<i>Allanblackia</i>	<i>stanerana</i>	<i>Artemisia</i>	<i>cana</i>
<i>Allanblackia</i>	<i>stuhlmannii</i>	<i>Artemisia</i>	<i>dracunculus</i>
<i>Allanblackia</i>	<i>ulugurensis</i>	<i>Artemisia</i>	<i>granatensis</i>
<i>Allium</i>	<i>angulosum</i>	<i>Artemisia</i>	<i>herba-alba</i>
<i>Allium</i>	<i>atrovioleaceum</i>	<i>Artemisia</i>	<i>Imperata cylindrica</i>
<i>Allium</i>	<i>oleraceum</i>	<i>Artemisia</i>	<i>lactiflora</i>
<i>Allium</i>	<i>schoenoprasum</i>	<i>Artemisia</i>	<i>ludoviciana</i>
<i>Allium</i>	<i>triccoccum</i>	<i>Artemisia</i>	<i>rothrockii</i>
<i>Allium</i>	<i>vineale</i>	<i>Artemisia</i>	<i>tripartita</i>
<i>Alocasia</i>	<i>macrorrhiza</i>	<i>Artemisia</i>	<i>vulgaris</i>
<i>Alocasia</i>	<i>sanderiana</i>	<i>Artocarpus</i>	<i>altilis</i>
		<i>Artocarpus</i>	<i>communis</i>

<i>Artocarpus</i>	<i>heterophyllus</i>	<i>Campomanesia</i>	<i>lineatifolia</i>
<i>Artocarpus</i>	<i>hypargyrea</i>	<i>Canarium</i>	<i>harveyi</i>
<i>Artocarpus</i>	<i>incisus</i>	<i>Canarium</i>	<i>indicum</i>
<i>Artocarpus</i>	<i>integer</i>	<i>Canarium</i>	<i>ovatum</i>
<i>Artocarpus</i>	<i>odoratissimus</i>	<i>Canarium</i>	<i>salomonense</i>
<i>Artocarpus</i>	<i>sericicarpus</i>	<i>Canavalia</i>	<i>ensiformis</i>
<i>Astrocaryum</i>	<i>vulgare</i>	<i>Canavalia</i>	<i>gladiata</i>
<i>Atriplex</i>	<i>halimus</i>	<i>Canna</i>	<i>edulis</i>
<i>Attalea</i>	<i>allenii</i>	<i>Capparis</i>	<i>cynophallophora</i>
<i>Attalea</i>	<i>cohune</i>	<i>Capparis</i>	<i>decidua</i>
<i>Avena</i>	<i>strigosa</i>	<i>Capparis</i>	<i>micracantha</i>
<i>Averrhoa</i>	<i>bilimbi</i>	<i>Capparis</i>	<i>spinosa</i>
<i>Azadirachta</i>	<i>indica</i>	<i>Carica</i>	<i>papaya</i>
<i>Bactris</i>	<i>gasipaes</i>	<i>Carissa</i>	<i>edulis</i>
<i>Balanites</i>	<i>aegyptiacus</i>	<i>Carthamus</i>	<i>laevis</i>
<i>Barringtonia</i>	<i>edulis</i>	<i>Carthamus</i>	<i>tinctorius</i>
<i>Barringtonia</i>	<i>novae-hiberniae</i>	<i>Carum</i>	<i>carvi</i>
<i>Barringtonia</i>	<i>procera</i>	<i>Carya</i>	<i>cathayensis</i>
<i>Basella</i>	<i>alba</i>	<i>Caryocar</i>	<i>glabrum</i>
<i>Basella</i>	<i>rubra</i>	<i>Caryocar</i>	<i>nuciferum</i>
<i>Beilschmiedia</i>	<i>mannii</i>	<i>Caryocar</i>	<i>villosum</i>
<i>Benincasa</i>	<i>hispida</i>	<i>Casimiroa</i>	<i>edulis</i>
<i>Berberis</i>	<i>vulgaris</i>	<i>Castanea</i>	<i>dentata</i>
<i>Bertholletia</i>	<i>excelsa</i>	<i>Castanea</i>	<i>mollissima</i>
<i>Bidens</i>	<i>pilosa</i>	<i>Castanea</i>	<i>pumila</i>
<i>Bixa</i>	<i>orellana</i>	<i>Celosia</i>	<i>argentea</i>
<i>Blighia</i>	<i>sapida</i>	<i>Celosia</i>	<i>trigyna</i>
<i>Boehmeria</i>	<i>nivea</i>	<i>Ceratonia</i>	<i>siliqua</i>
<i>Boerhavia</i>	<i>elegans</i>	<i>Ceratotheca</i>	<i>sesamoides</i>
<i>Bombacopsis</i>	<i>glabra</i>	<i>Cercidium</i>	<i>praecox</i>
<i>Borago</i>	<i>officinalis</i>	<i>Cereus</i>	<i>hexagonus</i>
<i>Borassus</i>	<i>aethiopum</i>	<i>Chamaedorea</i>	<i>tepejilote</i>
<i>Borojoa</i>	<i>patinoi</i>	<i>Chenopodium</i>	<i>album</i>
<i>Borojoa</i>	<i>sorbilis</i>	<i>Chenopodium</i>	<i>ambrosioides</i>
<i>Boscia</i>	<i>coriacea</i>	<i>Chenopodium</i>	<i>berlandieri</i>
<i>Boswellia</i>	<i>neglecta</i>	<i>Chenopodium</i>	<i>canihua</i>
<i>Brachiaria</i>	<i>deflexa</i>	<i>Chenopodium</i>	<i>pallidicaule</i>
<i>Brassica</i>	<i>carinata</i>	<i>Chenopodium</i>	<i>quinoa</i>
<i>Brassica</i>	<i>juncea</i>	<i>Chenopodium</i>	<i>rubrum</i>
<i>Bromelia</i>	<i>karatas</i>	<i>Choerospondias</i>	<i>axillaris</i>
<i>Brosimum</i>	<i>alicastrum</i>	<i>Chromolaena</i>	<i>odorata</i>
<i>Bunchosia</i>	<i>armeniaca</i>	<i>Chrysobalanus</i>	<i>icaco</i>
<i>Butyrospermum</i>	<i>parkii</i>	<i>Chrysophyllum</i>	<i>albidum</i>
<i>Byrsonima</i>	<i>crassifolia</i>	<i>Chrysophyllum</i>	<i>cainito</i>
<i>Cajanus</i>	<i>cajan</i>	<i>Cicerbita</i>	<i>alpina</i>
<i>Calamintha</i>	<i>officinalis</i>	<i>Cichorium</i>	<i>intybus</i>
<i>Calathea</i>	<i>allouia</i>	<i>Cichorium</i>	<i>pumilum</i>
<i>Calocarpum</i>	<i>mamosum</i>	<i>Cistus</i>	<i>crispus</i>
<i>Calocarpum</i>	<i>viride</i>	<i>Cistus</i>	<i>monspeliensis</i>
<i>Calycotome</i>	<i>intermedia</i>	<i>Cistus</i>	<i>salviifolius</i>
<i>Camelina</i>	<i>sativa</i>	<i>Citrullus</i>	<i>colocynthis</i>
<i>Campanula</i>	<i>rapunculus</i>	<i>Citrus</i>	<i>grandis</i>

<i>Cleistopholis</i>	<i>patens</i>	<i>Cyphomandra</i>	<i>betacea</i>
<i>Cleome</i>	<i>gynandra</i>	<i>Cyrtosperma</i>	<i>chamissonis</i>
<i>Clidemia</i>	<i>biformis</i>	<i>Dacryodes</i>	<i>edulis</i>
<i>Clidemia</i>	<i>petiolata</i>	<i>Dacryodes</i>	<i>klaineana</i>
<i>Clidemia</i>	<i>rubra</i>	<i>Dactylis</i>	<i>glomerata</i>
<i>Clitoria</i>	<i>ternatea</i>	<i>Daniellia</i>	<i>ogea</i>
<i>Cnidoscopus</i>	<i>chayamansa</i>	<i>Daphne</i>	<i>gnidium</i>
<i>Coccoloba</i>	<i>uvifera</i>	<i>Dialium</i>	<i>guineense</i>
<i>Coix</i>	<i>lacryma-jobi</i>	<i>Digitaria</i>	<i>exilis</i>
<i>Cola</i>	<i>lateritia</i>	<i>Dimocarpus</i>	<i>longan</i>
<i>Cola</i>	<i>lepidota</i>	<i>Dioscorea</i>	<i>alata</i>
<i>Cola</i>	<i>pachycarpa</i>	<i>Dioscorea</i>	<i>bulbifera</i>
<i>Coleus</i>	<i>dysentericus</i>	<i>Dioscorea</i>	<i>cayenensis</i>
<i>Colocasia</i>	<i>esculenta</i>	<i>Dioscorea</i>	<i>cotifolia</i>
<i>Colocynthis</i>	<i>citrullus</i>	<i>Dioscorea</i>	<i>dumetorum</i>
<i>Colocynthis</i>	<i>vulgaris</i>	<i>Dioscorea</i>	<i>esculenta</i>
<i>Commiphora</i>	<i>myrrha</i>	<i>Dioscorea</i>	<i>floribunda</i>
<i>Corchorus</i>	<i>olitorius</i>	<i>Dioscorea</i>	<i>hirtiflora</i>
<i>Cordeauxia</i>	<i>edulis</i>	<i>Dioscorea</i>	<i>nummularia</i>
<i>Cordia</i>	<i>obliqua</i>	<i>Dioscorea</i>	<i>pentaphylla</i>
<i>Coriandrum</i>	<i>sativum</i>	<i>Dioscorea</i>	<i>rotundata</i>
<i>Cornus</i>	<i>mas</i>	<i>Dioscorea</i>	<i>sansibarensis</i>
<i>Couepia</i>	<i>longipendula</i>	<i>Dioscorea</i>	<i>transversa</i>
<i>Coula</i>	<i>edulis</i>	<i>Dioscorea</i>	<i>trifida</i>
<i>Couma</i>	<i>utilis</i>	<i>Dioscorea</i>	<i>villosa</i>
<i>Crambe</i>	<i>cordifolia</i>	<i>Dioscorea</i>	<i>zingiberensis</i>
<i>Crassocephalum</i>	<i>crepidioides</i>	<i>Diospyros</i>	<i>digyna</i>
<i>Crataegus</i>	<i>monogyne</i>	<i>Diospyros</i>	<i>kaki</i>
<i>Crocus</i>	<i>sativus</i>	<i>Diospyros</i>	<i>mespilliformis</i>
<i>Crotalaria</i>	<i>arenaria</i>	<i>Diploaxis</i>	<i>muralis</i>
<i>Crotalaria</i>	<i>brevidens</i>	<i>Diploaxis</i>	<i>tenuifolia</i>
<i>Crotalaria</i>	<i>burhia</i>	<i>Dovyalis</i>	<i>caffra</i>
<i>Crotalaria</i>	<i>juncea</i>	<i>Dovyalis</i>	<i>hebecarpa</i>
<i>Crotalaria</i>	<i>longirostrata</i>	<i>Dovyalis</i>	<i>longispina</i>
<i>Crotalaria</i>	<i>micans</i>	<i>Duckesia</i>	<i>verrucosa</i>
<i>Crotalaria</i>	<i>ochroleuca</i>	<i>Duguetia</i>	<i>lepidota</i>
<i>Crotalaria</i>	<i>spectabilis</i>	<i>Durio</i>	<i>zibethinus</i>
<i>Cucumeropsis</i>	<i>edulis</i>	<i>Echinochloa</i>	<i>frumentacea</i>
<i>Cucumeropsis</i>	<i>mannii</i>	<i>Echinochloa</i>	<i>utilis</i>
<i>Cucurbita</i>	<i>foetidissima</i>	<i>Elaeagnus</i>	<i>angustifolia</i>
<i>Cucurbita</i>	<i>mixta</i>	<i>Elettaria</i>	<i>cardamomum</i>
<i>Cucurbita</i>	<i>moschata</i>	<i>Eleusine</i>	<i>coracana</i>
<i>Cuminum</i>	<i>cyminum</i>	<i>Emblica</i>	<i>officinalis</i>
<i>Cuphea</i>	<i>hyssopifolia</i>	<i>Ensete</i>	<i>ventricosum</i>
<i>Cuphea</i>	<i>micropetala</i>	<i>Enterolobium</i>	<i>cyclocarpum</i>
<i>Curcuma</i>	<i>angustifolia</i>	<i>Eragrostis</i>	<i>tef</i>
<i>Curcuma</i>	<i>aromatica</i>	<i>Erica</i>	<i>arborea</i>
<i>Curcuma</i>	<i>longa</i>	<i>Erica</i>	<i>scoparia</i>
<i>Cyamopsis</i>	<i>tetragonoloba</i>	<i>Eriobotrya</i>	<i>japonica</i>
<i>Cydonia</i>	<i>oblonga</i>	<i>Eruca</i>	<i>sativa</i>
<i>Cynara</i>	<i>cardunculus</i>	<i>Eruca</i>	<i>vesicaria</i>
<i>Cyperus</i>	<i>papyrus</i>	<i>Erythrina</i>	<i>edulis</i>

<i>Eugenia</i>	<i>dombeyi</i>	<i>Ipomoea</i>	<i>aquatica</i>
<i>Eugenia</i>	<i>latifolia</i>	<i>Irvingia</i>	<i>gabonensis</i>
<i>Eugenia</i>	<i>patrisii</i>	<i>Irvingia</i>	<i>wombolu</i>
<i>Eugenia</i>	<i>stipitata</i>	<i>Isatis</i>	<i>tinctoria</i>
<i>Eugenia</i>	<i>uniflora</i>	<i>Jatropha</i>	<i>curcas</i>
<i>Euphorbia</i>	<i>lagascae</i>	<i>Jatropha</i>	<i>tanjorensis</i>
<i>Euterpe</i>	<i>oleracea</i>	<i>Juglans</i>	<i>neotropica</i>
<i>Fadogia</i>	<i>ancylantha</i>	<i>Juglans</i>	<i>regia</i>
<i>Fagopyrum</i>	<i>esculentum</i>	<i>Kerstingiella</i>	<i>geocarpa</i>
<i>Fagopyrum</i>	<i>homotropicum</i>	<i>Kigelia</i>	<i>africana</i>
<i>Fagopyrum</i>	<i>tataricum</i>	<i>Lablab</i>	<i>purpureus</i>
<i>Feijoa</i>	<i>sellowiana</i>	<i>Lagenaria</i>	<i>siceraria</i>
<i>Ficus</i>	<i>carica</i>	<i>Lagenaria</i>	<i>sphaerica</i>
<i>Fimbristylis</i>	<i>spp.</i>	<i>Lathyrus</i>	<i>articulatus</i>
<i>Flemingia</i>	<i>congesta</i>	<i>Lathyrus</i>	<i>cicera</i>
<i>Garcinia</i>	<i>afzelii</i>	<i>Lathyrus</i>	<i>jepsonii</i>
<i>Garcinia</i>	<i>indica</i>	<i>Lathyrus</i>	<i>ochroleucus</i>
<i>Garcinia</i>	<i>kola</i>	<i>Lathyrus</i>	<i>odoratus</i>
<i>Garcinia</i>	<i>mangostana</i>	<i>Lathyrus</i>	<i>sativus</i>
<i>Genipa</i>	<i>americana</i>	<i>Laurus</i>	<i>nobilis</i>
<i>Gliricidia</i>	<i>sepium</i>	<i>Lavandula</i>	<i>multifida</i>
<i>Glossostemon</i>	<i>bruguieri</i>	<i>Lavandula</i>	<i>stoechas</i>
<i>Glycyrrhiza</i>	<i>glabra</i>	<i>Lawsonia</i>	<i>inermis</i>
<i>Gnetum</i>	<i>africanum</i>	<i>Lecythis</i>	<i>minor</i>
<i>Grewia</i>	<i>asiatica</i>	<i>Lecythis</i>	<i>ollaria</i>
<i>Grewia</i>	<i>tenax</i>	<i>Lecythis</i>	<i>pisonis</i>
<i>Grias</i>	<i>peruviana</i>	<i>Lepidium</i>	<i>meyenii</i>
<i>Guizotia</i>	<i>abyssinica</i>	<i>Lesquerella</i>	<i>fendleri</i>
<i>Gundelia</i>	<i>tournefortii</i>	<i>Leucaena</i>	<i>leucocephala</i>
<i>Gustavia</i>	<i>macarenensis</i>	<i>Linum</i>	<i>usitatissimum</i>
<i>Gustavia</i>	<i>superba</i>	<i>Lippia</i>	<i>citrodora</i>
<i>Gynandropsis</i>	<i>gynandra</i>	<i>Lippia</i>	<i>multiflora</i>
<i>Haematoxylum</i>	<i>campechianum</i>	<i>Litchi</i>	<i>chinensis</i>
<i>Hancornia</i>	<i>speciosa</i>	<i>Lonchocarpus</i>	<i>sericeus</i>
<i>Harpagophytum</i>	<i>procumbens</i>	<i>Lucuma</i>	<i>obovata</i>
<i>Helichrysum</i>	<i>arenarium</i>	<i>Luffa</i>	<i>cylindrica</i>
<i>Hibiscus</i>	<i>cannabinus</i>	<i>Lupinus</i>	<i>albus</i>
<i>Hibiscus</i>	<i>sabdariffa</i>	<i>Lupinus</i>	<i>angustifolius</i>
<i>Hippophae</i>	<i>ramnoides</i>	<i>Lupinus</i>	<i>arboreus</i>
<i>Hovenia</i>	<i>dulcis</i>	<i>Lupinus</i>	<i>luteus</i>
<i>Hylocereus</i>	<i>purpusii</i>	<i>Lupinus</i>	<i>mutabilis</i>
<i>Hylocereus</i>	<i>triangularis</i>	<i>Lupinus</i>	<i>perennis</i>
<i>Hylocereus</i>	<i>undatus</i>	<i>Lupinus</i>	<i>sulphureus</i>
<i>Imperata</i>	<i>cylindrica</i>	<i>Macrotyloma</i>	<i>uniflorum</i>
<i>Inga</i>	<i>edulis</i>	<i>Malpighia</i>	<i>glabra</i>
<i>Inga</i>	<i>feuilleei</i>	<i>Malus</i>	<i>sieversii</i>
<i>Inga</i>	<i>laurina</i>	<i>Malva</i>	<i>alcea</i>
<i>Inga</i>	<i>meissneriana</i>	<i>Malva</i>	<i>pusilla</i>
<i>Inga</i>	<i>stipularis</i>	<i>Malva</i>	<i>sylvestris</i>
<i>Inga</i>	<i>vera</i>	<i>Mammea</i>	<i>americana</i>
<i>Inocarpus</i>	<i>fagifer</i>	<i>Mangifera</i>	<i>caesia</i>
<i>Inula</i>	<i>viscosa</i>	<i>Mangifera</i>	<i>indica</i>

<i>Mangifera</i>	<i>odorata</i>	<i>Opuntia</i>	<i>ficus-indica</i>
<i>Mangifera</i>	<i>pajang</i>	<i>Opuntia</i>	<i>humifusa</i>
<i>Mangifera</i>	<i>zeylanica</i>	<i>Opuntia</i>	<i>maxima</i>
<i>Manilkara</i>	<i>zapota</i>	<i>Orbignya</i>	<i>phalerata</i>
<i>Maranta</i>	<i>arundinacea</i>	<i>Origanum</i>	<i>dictamnus</i>
<i>Matisia</i>	<i>cordata</i>	<i>Origanum</i>	<i>dubium</i>
<i>Mauritia</i>	<i>flexuosa</i>	<i>Origanum</i>	<i>sativum</i>
<i>Maximiliana</i>	<i>maripa</i>	<i>Origanum</i>	<i>syriacum</i>
<i>Maytenus</i>	<i>ebenifolia</i>	<i>Origanum</i>	<i>vulgare</i>
<i>Maytenus</i>	<i>krukovii</i>	<i>Oxalis</i>	<i>tuberosa</i>
<i>Maytenus</i>	<i>laevis</i>	<i>Pachira</i>	<i>aquatica</i>
<i>Maytenus</i>	<i>macrocarpa</i>	<i>Pachyrhizus</i>	<i>ahipa</i>
<i>Medicago</i>	<i>truncatula</i>	<i>Pachyrhizus</i>	<i>erosus</i>
<i>Melicoccus</i>	<i>bijugatus</i>	<i>Pachyrhizus</i>	<i>tuberosus</i>
<i>Mentha</i>	<i>piperita</i>	<i>Pandanus</i>	<i>conoideus</i>
<i>Mentha</i>	<i>pulegium</i>	<i>Pandanus</i>	<i>dubius</i>
<i>Metroxylon</i>	<i>sagu</i>	<i>Pandanus</i>	<i>julianetti</i>
<i>Millettia</i>	<i>thonningii</i>	<i>Panicum</i>	<i>amarum</i>
<i>Mirabilis</i>	<i>expansa</i>	<i>Panicum</i>	<i>hemitomom</i>
<i>Momordica</i>	<i>balsamina</i>	<i>Panicum</i>	<i>latum</i>
<i>Momordica</i>	<i>charantia</i>	<i>Panicum</i>	<i>miliaceum</i>
<i>Momordica</i>	<i>dioica</i>	<i>Panicum</i>	<i>miliare</i>
<i>Monstera</i>	<i>deliciosa</i>	<i>Panicum</i>	<i>repens</i>
<i>Morinda</i>	<i>citrifolia</i>	<i>Panicum</i>	<i>sumatrense</i>
<i>Moringa</i>	<i>oleifera</i>	<i>Panicum</i>	<i>virgatum</i>
<i>Moringa</i>	<i>peregrina</i>	<i>Parkia</i>	<i>biglobosa</i>
<i>Moringa</i>	<i>stenopetala</i>	<i>Parthenium</i>	<i>argentatum</i>
<i>Morrenia</i>	<i>odorata</i>	<i>Paspalum</i>	<i>scrobiculatum</i>
<i>Mucuna</i>	<i>aterrima</i>	<i>Passiflora</i>	<i>alata</i>
<i>Mucuna</i>	<i>deeringiana</i>	<i>Passiflora</i>	<i>antioquiensis</i>
<i>Mucuna</i>	<i>enana</i>	<i>Passiflora</i>	<i>caerulea</i>
<i>Mucuna</i>	<i>pruriens</i>	<i>Passiflora</i>	<i>capsularis</i>
<i>Mucuna</i>	<i>prurita</i>	<i>Passiflora</i>	<i>cinninata</i>
<i>Mucuna</i>	<i>sloanei</i>	<i>Passiflora</i>	<i>coccinea</i>
<i>Musa</i>	<i>textilis</i>	<i>Passiflora</i>	<i>cumbalensis</i>
<i>Myrciaria</i>	<i>cauliflora</i>	<i>Passiflora</i>	<i>edulis</i>
<i>Myrciaria</i>	<i>dubia</i>	<i>Passiflora</i>	<i>foetida</i>
<i>Myrianthus</i>	<i>arboreus</i>	<i>Passiflora</i>	<i>gabrielliana</i>
<i>Myroxylon</i>	<i>balsamum</i>	<i>Passiflora</i>	<i>laurifolia</i>
<i>Myrthus</i>	<i>communis</i>	<i>Passiflora</i>	<i>ligularis</i>
<i>Myrtillocactus</i>	<i>schenki</i>	<i>Passiflora</i>	<i>maliformis</i>
<i>Napoleonaea</i>	<i>vogelii</i>	<i>Passiflora</i>	<i>manicata</i>
<i>Nephelium</i>	<i>lappaceum</i>	<i>Passiflora</i>	<i>mixta</i>
<i>Nephelium</i>	<i>mutabile</i>	<i>Passiflora</i>	<i>mollissima</i>
<i>Nephelium</i>	<i>ramboutan-ake</i>	<i>Passiflora</i>	<i>nitida</i>
<i>Nigella</i>	<i>damascena</i>	<i>Passiflora</i>	<i>pergrandis</i>
<i>Nigella</i>	<i>sativa</i>	<i>Passiflora</i>	<i>pinatistipula</i>
<i>Ocimum</i>	<i>gratissimum</i>	<i>Passiflora</i>	<i>popenovii</i>
<i>Oenocarpus</i>	<i>bacaba</i>	<i>Passiflora</i>	<i>quadrangularis</i>
<i>Oenocarpus</i>	<i>bataua</i>	<i>Passiflora</i>	<i>tarminiana</i>
<i>Opuntia</i>	<i>coccinellifera</i>	<i>Passiflora</i>	<i>tiliifolia</i>
<i>Opuntia</i>	<i>compressa</i>	<i>Passiflora</i>	<i>tripartita</i>

<i>Pastinaca</i>	<i>sativa</i>	<i>Prunus</i>	<i>nigra</i>
<i>Patinoa</i>	<i>almirajo</i>	<i>Prunus</i>	<i>petunnikova</i>
<i>Paullinia</i>	<i>cupana</i>	<i>Prunus</i>	<i>salicifolia</i>
<i>Pennisetum</i>	<i>americanum</i>	<i>Prunus</i>	<i>sargentii</i>
<i>Perilla</i>	<i>frutescens</i>	<i>Prunus</i>	<i>serotina</i>
<i>Persea</i>	<i>americana</i>	<i>Prunus</i>	<i>spinosa</i>
<i>Phaseolus</i>	<i>angularis</i>	<i>Prunus</i>	<i>spinosissima</i>
<i>Phaseolus</i>	<i>lunatus</i>	<i>Prunus</i>	<i>subhirtella</i>
<i>Phoenix</i>	<i>dactylifera</i>	<i>Prunus</i>	<i>triloba</i>
<i>Phyllanthus</i>	<i>acidus</i>	<i>Prunus</i>	<i>virginiana</i>
<i>Phyllanthus</i>	<i>emblica</i>	<i>Psidium</i>	<i>angulatum</i>
<i>Phyllanthus</i>	<i>niruri</i>	<i>Psidium</i>	<i>cattleianum</i>
<i>Phyllanthus</i>	<i>niruroides</i>	<i>Psidium</i>	<i>guajava</i>
<i>Physalis</i>	<i>alkekengi</i>	<i>Psophocarpus</i>	<i>tetragonolobus</i>
<i>Physalis</i>	<i>peruviana</i>	<i>Pterocarpus</i>	<i>osun</i>
<i>Physalis</i>	<i>philadelphica</i>	<i>Punica</i>	<i>granatum</i>
<i>Physalis</i>	<i>pubescens</i>	<i>Pyrus</i>	<i>caucasica</i>
<i>Phytolacca</i>	<i>acinosa</i>	<i>Quercus</i>	<i>acutissima</i>
<i>Pistacia</i>	<i>atlantica</i>	<i>Quercus</i>	<i>alba</i>
<i>Pistacia</i>	<i>chinensis</i>	<i>Quercus</i>	<i>bicolor</i>
<i>Pistacia</i>	<i>lentiscus</i>	<i>Quercus</i>	<i>coccinea</i>
<i>Pistacia</i>	<i>vera</i>	<i>Quercus</i>	<i>douglasii</i>
<i>Pisum</i>	<i>fulvum</i>	<i>Quercus</i>	<i>engelmannii</i>
<i>Pithecellobium</i>	<i>dulce</i>	<i>Quercus</i>	<i>garryana</i>
<i>Plantago</i>	<i>suckers</i>	<i>Quercus</i>	<i>geminata</i>
<i>Platonia</i>	<i>insignis</i>	<i>Quercus</i>	<i>hiholensis</i>
<i>Plectranthus</i>	<i>esculentus</i>	<i>Quercus</i>	<i>macrocarpa</i>
<i>Pongamia</i>	<i>pinnata</i>	<i>Quercus</i>	<i>muehlenbergii</i>
<i>Poraqueiba</i>	<i>sericea</i>	<i>Quercus</i>	<i>nigra</i>
<i>Portulaca</i>	<i>oleracea</i>	<i>Quercus</i>	<i>palustris</i>
<i>Portulaca</i>	<i>portulaca</i>	<i>Raphia</i>	<i>australis</i>
<i>Pourouma</i>	<i>cecropiifolia</i>	<i>Raphia</i>	<i>farinifera</i>
<i>Pouteria</i>	<i>caimito</i>	<i>Raphia</i>	<i>hookeri</i>
<i>Pouteria</i>	<i>campechiana</i>	<i>Raphanus</i>	<i>sativus</i>
<i>Pouteria</i>	<i>lucuma</i>	<i>Rheedia</i>	<i>madruno</i>
<i>Pouteria</i>	<i>macrocarpa</i>	<i>Rhus</i>	<i>coriaria</i>
<i>Pouteria</i>	<i>macrophylla</i>	<i>Ricinodendron</i>	<i>heudelotii</i>
<i>Pouteria</i>	<i>sapota</i>	<i>Ricinodendron</i>	<i>rautanenii</i>
<i>Pouteria</i>	<i>speciosa</i>	<i>Ricinus</i>	<i>communis</i>
<i>Prosopis</i>	<i>africana</i>	<i>Rollinia</i>	<i>mucosa</i>
<i>Prunus</i>	<i>africana</i>	<i>Rollinia</i>	<i>pulchrinervia</i>
<i>Prunus</i>	<i>angustifolia</i>	<i>Rorippa</i>	<i>indica</i>
<i>Prunus</i>	<i>bucharica</i>	<i>Rosmarinus</i>	<i>officinalis</i>
<i>Prunus</i>	<i>capuli</i>	<i>Rubus</i>	<i>idaeus</i>
<i>Prunus</i>	<i>communis</i>	<i>Saba</i>	<i>florida</i>
<i>Prunus</i>	<i>emarginata</i>	<i>Salacca</i>	<i>zalacca</i>
<i>Prunus</i>	<i>geniculata</i>	<i>Salsola</i>	<i>soda</i>
<i>Prunus</i>	<i>laurocerasus</i>	<i>Salsola</i>	<i>vermiculata</i>
<i>Prunus</i>	<i>lusitanica</i>	<i>Salvia</i>	<i>aucheri</i>
<i>Prunus</i>	<i>maritima</i>	<i>Salvia</i>	<i>bengalensis</i>
<i>Prunus</i>	<i>mexicana</i>	<i>Salvia</i>	<i>hispanica</i>
<i>Prunus</i>	<i>mume</i>	<i>Santalum</i>	<i>austrocaledonicum</i>

<i>Santalum</i>	<i>lanceolatum</i>	<i>Tetraclinis</i>	<i>articulata</i>
<i>Sclerocarya</i>	<i>birrea</i>	<i>Theobroma</i>	<i>bicolor</i>
<i>Scolymus</i>	<i>hispanicus</i>	<i>Theobroma</i>	<i>grandiflorum</i>
<i>Sechium</i>	<i>edule</i>	<i>Thymus</i>	<i>mastichina</i>
<i>Sesamum</i>	<i>angustifolium</i>	<i>Thymus</i>	<i>oblongifolius</i>
<i>Sesamum</i>	<i>indicum</i>	<i>Thymus</i>	<i>pulegioides</i>
<i>Sesamum</i>	<i>radiatum</i>	<i>Thymus</i>	<i>satureioides</i>
<i>Sesamum</i>	<i>triphyllum</i>	<i>Thymus</i>	<i>serpyllum</i>
<i>Sesbania</i>	<i>sesban</i>	<i>Tieghemella</i>	<i>heckelii</i>
<i>Setaria</i>	<i>italica</i>	<i>Treculia</i>	<i>africana</i>
<i>Simmondsia</i>	<i>chinensis</i>	<i>Trichoscypha</i>	<i>arborea</i>
<i>Smallanthus</i>	<i>sonchifolius</i>	<i>Trigonella</i>	<i>foenum</i>
<i>Solanecio</i>	<i>biafrae</i>	<i>Triticum</i>	<i>dicoccon</i>
<i>Solanum</i>	<i>aethiopicum</i>	<i>Triticum</i>	<i>monococcum</i>
<i>Solanum</i>	<i>americanum</i>	<i>Triticum</i>	<i>spelta</i>
<i>Solanum</i>	<i>betaceum</i>	<i>Tropaeolum</i>	<i>majus</i>
<i>Solanum</i>	<i>macrocarpon</i>	<i>Tropaeolum</i>	<i>tuberosum</i>
<i>Solanum</i>	<i>melongena</i>		
<i>Solanum</i>	<i>muricatum</i>	<i>Tylosema</i>	<i>esculentum</i>
<i>Solanum</i>	<i>nigrum</i>	<i>Tylosema</i>	<i>fassoglense</i>
<i>Solanum</i>	<i>quitoense</i>	<i>Typha</i>	<i>domingensis</i>
<i>Solanum</i>	<i>scabrum</i>	<i>Uapaca</i>	<i>kirkiana</i>
<i>Solanum</i>	<i>sessiliflorum</i>	<i>Ullucus</i>	<i>tuberosus</i>
<i>Solanum</i>	<i>stramoniifolium</i>	<i>Uvaria</i>	<i>chamae</i>
<i>Solanum</i>	<i>villosum</i>	<i>Valerianella</i>	<i>locusta</i>
<i>Solenostemma</i>	<i>arghel</i>	<i>Vangueria</i>	<i>infausta</i>
<i>Solenostemon</i>	<i>rotundifolius</i>	<i>Vangueria</i>	<i>madagascariensis</i>
<i>Spathodea</i>	<i>campanulata</i>	<i>Vangueria</i>	<i>tomentosa</i>
<i>Sphenostylis</i>	<i>stenocarpa</i>	<i>Vasconcellea</i>	<i>cauliflora</i>
<i>Spondias</i>	<i>cytherea</i>	<i>Vasconcellea</i>	<i>cundinamarcensis</i>
<i>Spondias</i>	<i>lutea</i>	<i>Vernonia</i>	<i>amygdalina</i>
<i>Spondias</i>	<i>mombin</i>	<i>Vernonia</i>	<i>calvoana</i>
<i>Spondias</i>	<i>purpurea</i>	<i>Vernonia</i>	<i>cinerascens</i>
<i>Sterculia</i>	<i>quadrifida</i>	<i>Vernonia</i>	<i>galamensis</i>
<i>Stevia</i>	<i>rebaudiana</i>	<i>Vernonia</i>	<i>noveboracensis</i>
<i>Stipa</i>	<i>lagascae</i>	<i>Veronica</i>	<i>amygdalina</i>
<i>Stipa</i>	<i>tenacissima</i>	<i>Veronica</i>	<i>hymenolepis</i>
<i>Strychnos</i>	<i>cocculoides</i>	<i>Vetiveria</i>	<i>zizanioides</i>
<i>Strychnos</i>	<i>spinosa</i>	<i>Vigna</i>	<i>aconitifolia</i>
<i>Symphytum</i>	<i>officinale</i>	<i>Vigna</i>	<i>angularis</i>
<i>Synsepalum</i>	<i>dulcificum</i>	<i>Vigna</i>	<i>radiata</i>
<i>Syzygium</i>	<i>aqueum</i>	<i>Vigna</i>	<i>subterranea</i>
<i>Syzygium</i>	<i>cumini</i>	<i>Vigna</i>	<i>umbellata</i>
<i>Talinum</i>	<i>triangulare</i>	<i>Vigna</i>	<i>vexillata</i>
<i>Talisia</i>	<i>esculenta</i>	<i>Vitellaria</i>	<i>paradoxa</i>
<i>Tamarindus</i>	<i>indica</i>	<i>Vitex</i>	<i>doniana</i>
<i>Tamarix</i>	<i>aphylla</i>	<i>Voandzeia</i>	<i>subterranea</i>
<i>Telfairia</i>	<i>occidentalis</i>	<i>Xanthosoma</i>	<i>sagittifolium</i>
<i>Terminalia</i>	<i>catappa</i>	<i>Zingiber</i>	<i>officinale</i>
<i>Terminalia</i>	<i>kaernbachii</i>	<i>Ziziphus</i>	<i>jujuba</i>
<i>Terminalia</i>	<i>kaernbachii</i>	<i>Ziziphus</i>	<i>mauritiana</i>
<i>Tetracarpidium</i>	<i>conophorum</i>	<i>Ziziphus</i>	<i>mistol</i>

## **Annex 4: System Priorities for CGIAR Research 2005-2015**

### **Priority area 1: Sustaining biodiversity for current and future generations**

Priority 1A: Promoting conservation and characterization of staple crops

Priority 1B: Promoting conservation and characterization of underutilized plant genetic resources

Priority 1C: Promoting conservation of indigenous livestock

Priority 1D: Promoting conservation of aquatic animal genetic resources

### **Priority area 2: Producing more and better food at lower cost through genetic improvements**

Priority 2A: Maintaining and enhancing yields and yield potential of food staples

Priority 2B: Improving tolerance to selected abiotic stresses

Priority 2C: Enhancing nutritional quality and safety

Priority 2D: Genetically enhancing selected high-value species

### **Priority area 3: Reducing rural poverty through agricultural diversification and emerging opportunities for high-value commodities and products**

Priority 3A: Increasing income from fruit and vegetables

Priority 3B: Increasing income from livestock

Priority 3C: Enhancing income through increased productivity of fisheries and aquaculture

Priority 3D: Promoting sustainable income generation from forests and trees

### **Priority area 4: Promoting poverty alleviation and sustainable management of water, land, and forest resources**

Priority 4A: Promoting integrated land, water and forest management at landscape level

Priority 4B: Sustaining and managing aquatic ecosystems for food and livelihoods

Priority 4C: Improving water productivity

Priority 4D: Promoting sustainable agro-ecological intensification in low- and high-potential areas

### **Priority area 5: Improving policies and facilitating institutional innovation to support sustainable reduction of poverty and hunger**

Priority 5A: Improving science and technology policies and institutions

Priority 5B: Making international and domestic markets work for the poor

Priority 5C: Improving rural institutions and their governance

Priority 5D: Improving research and development options to reduce rural poverty and vulnerability



## Annex 5: List of forest species addressed by a project at the World Agroforestry Centre (ICRAF)

List of tree species from the Project 'Vegetation maps for land rehabilitation' in the 'Tree Product Market MTP project' (Source: [www.worldagroforestrycentre.org](http://www.worldagroforestrycentre.org) accessed on 12 November, 2007)

<i>Abutilon longicuspe</i>	<i>Antiaris toxicaria</i>	<i>Chassalia kenyensis</i>
<i>Acacia abyssinica</i>	<i>Anthocleista grandiflora</i>	<i>Chrysophyllum albidum</i>
<i>Acacia brevispica</i>	<i>Apodytes dimidiata</i>	<i>Chrysophyllum gorungosanum</i>
<i>Acacia bussei</i>	<i>Arundinaria alpina</i>	<i>Chrysophyllum viridifolium</i>
<i>Acacia drepanolobium</i>	<i>Azanza garckeana</i>	<i>Cissus quadrangularis</i>
<i>Acacia elatior</i>	<i>Azima tetracantha</i>	<i>Cissus rotundifolia</i>
<i>Acacia etbaica</i>	<i>Balanites aegyptiacus</i>	<i>Coffea fadenii</i>
<i>Acacia gerrardii</i>	<i>Balanites rotundifolia</i>	<i>Cola greenwayi</i>
<i>Acacia hockii</i>	<i>Bauhinia taitensis</i>	<i>Combretum aculeatum</i>
<i>Acacia kirkii</i>	<i>Bequaertiodendron oblanceolatum</i>	<i>Combretum collinum</i>
<i>Acacia lahai</i>	<i>Berchemia discolor</i>	<i>Combretum molle</i>
<i>Acacia mellifera</i>	<i>Bersama abyssinica</i>	<i>Combretum zeyheri</i>
<i>Acacia nilotica ssp nilotica</i>	<i>Blighia unijugata</i>	<i>Commiphora africana</i>
<i>Acacia polyacantha ssp. campylacantha</i>	<i>Borassus aethiopicum</i>	<i>Commiphora campestris</i>
<i>Acacia reficiens</i>	<i>Boscia angustifolia</i>	<i>Commiphora edulis</i>
<i>Acacia senegal</i>	<i>Boscia coriacea</i>	<i>Commiphora holtziana</i>
<i>Acacia seyal</i>	<i>Boswellia neglecta</i>	<i>Commiphora mollis</i>
<i>Acacia sieberiana</i>	<i>Bourreria teitensis</i>	<i>Commiphora schimperii</i>
<i>Acacia thomasii</i>	<i>Brachylaena huillensis</i>	<i>Cordia africana</i>
<i>Acacia tortilis</i>	<i>Bridelia micrantha</i>	<i>Cordia millenii</i>
<i>Acacia xanthophloea</i>	<i>Bridelia taitensis</i>	<i>Cordia monoica</i>
<i>Acalypha fruticosa</i>	<i>Cadaba farinosa</i>	<i>Cordia sinensis</i>
<i>Acokanthera schimperii</i>	<i>Cadaba heterotricha</i>	<i>Craibia brownii</i>
<i>Adansonia digitata</i>	<i>Caesalpinia trochae</i>	<i>Craibia zimmermannii</i>
<i>Adenia metriosiphon</i>	<i>Calodendrum capense</i>	<i>Crotalaria goodiaeformis</i>
<i>Adenium obesum</i>	<i>Calyptrotheca somalensis</i>	<i>Croton dichogamus</i>
<i>Afrocrania volkensii</i>	<i>Calyptrotheca taitensis</i>	<i>Croton macrostachyus</i>
<i>Afrosersalisia cerasifera</i>	<i>Canthium guineense</i>	<i>Croton megalocarpus</i>
<i>Alangium chinense</i>	<i>Canthium keniense</i>	<i>Croton sylvaticus</i>
<i>Albizia amara</i>	<i>Canthium oligocarpum</i>	<i>Cussonia arborea</i>
<i>Albizia anthelmintica</i>	<i>Capparis fascicularis</i>	<i>Cussonia holstii</i>
<i>Albizia coriaria</i>	<i>Capparis tomentosa</i>	<i>Cussonia spicata</i>
<i>Albizia grandibracteata</i>	<i>Carissa edulis</i>	<i>Cylicomorpha parviflora</i>
<i>Albizia gummifera</i>	<i>Carphalea glaucescens</i>	<i>Dalbergia melanoxylon</i>
<i>Albizia harveyi</i>	<i>Casearia battiscombei</i>	<i>Delonix elata</i>
<i>Albizia schimperiana</i>	<i>Cassia abbreviata ssp. kassneri</i>	<i>Dichrostachys cinerea</i>
<i>Albizia zygia</i>	<i>Cassipourea gummiflua</i>	<i>Diospyros abyssinica</i>
<i>Allophylus abyssinicus</i>	<i>Cassipourea malosana</i>	<i>Diospyros mespiliformis</i>
<i>Allophylus africanus</i>	<i>Cassipourea rotundifolia</i>	<i>Dobera glabra</i>
<i>Allophylus ferrugineus</i>	<i>Cassipourea ruwensorensis</i>	<i>Dobera loranthifolia</i>
<i>Aloe kedongensis</i>	<i>Catha edulis</i>	<i>Dodonaea viscosa</i>
<i>Aningeria adolfi-friedericii</i>	<i>Caucanthus albidus</i>	<i>Dombeya burgessiae</i>
<i>Aningeria altissima</i>	<i>Celtis africana</i>	<i>Dombeya torrida</i>
<i>Annona senegalensis</i>	<i>Celtis gomphophylla</i>	<i>Dovyalis abyssinica</i>
<i>Anthocleista grandiflora</i>	<i>Celtis mildbraedii</i>	<i>Dracaena afromontana</i>
<i>Anthocleista vogelii</i>	<i>Chaetacme aristata</i>	<i>Dracaena ellenbeckiana</i>

<i>Dracaena steudneri</i>	<i>Halleria lucida</i>	<i>Mystroxydon aethiopicum</i>
<i>Drypetes gerrardii</i>	<i>Harrisonia abyssinica</i>	<i>Nauclea latifolia</i>
<i>Ehretia cymosa</i>	<i>Harungana madagascariensis</i>	<i>Neoboutonia macrocalyx</i>
<i>Ekebergia capensis</i>	<i>Heinsenia diervillioides</i>	<i>Newtonia buchananii</i>
<i>Elaeodendron buchananii</i>	<i>Heywoodia lucens</i>	<i>Nuxia congesta</i>
<i>Embelia keniensis</i>	<i>Hymenocardia acida</i>	<i>Nuxia floribunda</i>
<i>Entada abyssinica</i>	<i>Hymenodictyon parvifolium</i>	<i>Ochna holstii</i>
<i>Entandrophragma angolense</i>	<i>Hypericum revolutum</i>	<i>Ochna keniensis</i>
<i>Entandrophragma excelsum</i>	<i>Ilex mitis</i>	<i>Ochna ovata</i>
<i>Erythrina abyssinica</i>	<i>Ixora scheffleri</i> ssp. <i>keniensis</i>	<i>Ocotea kenyensis</i>
<i>Erythrochlamys spectabilis</i>	<i>Juniperus procera</i>	<i>Ocotea usambarensis</i>
<i>Erythrococca bongensis</i>	<i>Kedrostis gijef</i>	<i>Olea capensis</i>
<i>Euclea divinorum</i>	<i>Kigelia moosa</i>	<i>Olea europaea</i> ssp. <i>africana</i>
<i>Euclea racemosa</i> ssp. <i>schimperi</i>	<i>Kigelia pinnata</i>	<i>Olinia rochetiana</i>
<i>Euphorbia candelabrum</i>	<i>Lannea alata</i>	<i>Oxyanthus speciosus</i>
<i>Euphorbia cussonioides</i>	<i>Lannea humilis</i>	<i>Ozoroa insignis</i>
<i>Euphorbia nyikae</i>	<i>Lannea schweinfurthii</i>	<i>Parinari curatellifolia</i>
<i>Euphorbia obovalifolia</i>	<i>Lannea triphylla</i>	<i>Phoenix reclinata</i>
<i>Euphorbia quinquecostata</i>	<i>Lawsonia inermis</i>	<i>Piliostigma thonningii</i>
<i>Euphorbia robecchii</i>	<i>Lecaniodiscus fraxinifolius</i>	<i>Pistacia aethiopica</i>
<i>Euphorbia scheffleri</i>	<i>Lepidotrichilia volkensii</i>	<i>Pittosporum lanatum</i>
<i>Euphorbia tirucalli</i>	<i>Lepisanthes senegalensis</i>	<i>Pittosporum viridiflorum</i>
<i>Fagaropsis angolensis</i>	<i>Lovoa swynnertonii</i>	<i>Platycelyphium voense</i>
<i>Faidherbia albida</i>	<i>Macaranga capensis</i>	<i>Podocarpus falcatus</i>
<i>Faurea rochetiana</i>	<i>Macaranga kilimandscharica</i>	<i>Podocarpus latifolius</i>
<i>Faurea saligna</i>	<i>Maerua decumbens</i>	<i>Polyscias fulva</i>
<i>Ficus amadiensis</i>	<i>Maerua denhardtiorum</i>	<i>Polyscias kikuyuensis</i>
<i>Ficus exasperata</i>	<i>Maerua triphylla</i>	<i>Premna angolensis</i>
<i>Ficus glumosa</i>	<i>Maesa lanceolata</i>	<i>Premna hildebrandtii</i>
<i>Ficus lutea</i>	<i>Maesopsis eminii</i>	<i>Premna maxima</i>
<i>Ficus saussureana</i>	<i>Manilkara butugi</i>	<i>Premna resinosa</i>
<i>Ficus sur</i>	<i>Manilkara discolor</i>	<i>Prunus africana</i>
<i>Ficus sycomorus</i>	<i>Margaritaria discoidea</i>	<i>Pseudospondias microcarpa</i>
<i>Ficus thonningii</i>	<i>Markhamia lutea</i>	<i>Psidium punctulata</i>
<i>Flacourtia indica</i>	<i>Maytenus acuminata</i>	<i>Psorospermum febrifugum</i>
<i>Funtumia africana</i>	<i>Maytenus heterophylla</i>	<i>Psychotria crassipetala</i>
<i>Galiniera saxifraga</i>	<i>Maytenus keniensis</i>	<i>Psychotria mahonii</i>
<i>Garcinia buchananii</i>	<i>Maytenus senegalensis</i>	<i>Psychotria petiti</i>
<i>Garcinia livingstonei</i>	<i>Maytenus undata</i>	<i>Psydrax parviflora</i>
<i>Garcinia volkensii</i>	<i>Melia volkensii</i>	<i>Psydrax schimperiana</i>
<i>Gardenia ternifolia</i>	<i>Memecylon teitense</i>	<i>Pterolobium stellatum</i>
<i>Gerrardanthus lobatus</i>	<i>Millicia excelsa</i>	<i>Rapanea melanophloeos</i>
<i>Givotia gosai</i>	<i>Millettia dura</i>	<i>Rauvolfia caffra</i>
<i>Gnidia glauca</i>	<i>Millettia oblata</i> ssp. <i>teitensis</i>	<i>Rawsonia lucida</i>
<i>Gnidia subcordata</i>	<i>Mimusops bagshawei</i>	<i>Rhus natalensis</i>
<i>Grewia bicolor</i>	<i>Mimusops kummel</i>	<i>Rinorea convallarioides</i> ssp. <i>marsabitensis</i>
<i>Grewia fallax</i>	<i>Mitragyna rubrostipulata</i>	<i>Ritchiea albersii</i>
<i>Grewia similis</i>	<i>Monodora myristica</i>	<i>Rothmannia urcelliformis</i>
<i>Grewia tembensis</i>	<i>Morus mesozygia</i>	<i>Rubus ikenoensis</i>
<i>Grewia tenax</i>	<i>Myrianthus holstii</i>	<i>Salvadora persica</i>
<i>Grewia villosa</i>	<i>Myrica salicifolia</i>	<i>Sapium ellipticum</i>
<i>Hagenia abyssinica</i>	<i>Myrsine africana</i>	<i>Schefflera abyssinica</i>

<i>Schefflera volkensii</i>	<i>Tabernaemontana stapfiana</i>	<i>Turraea holstii</i>
<i>Schrebera alata</i>	<i>Tabernaemontana ventricosa</i>	<i>Turraea mombassana</i>
<i>Sclerocarya birrea</i> ssp. <i>caffra</i>	<i>Tamarindus indica</i>	<i>Turraea nilotica</i>
<i>Scutia myrtina</i>	<i>Tarchonanthus camphoratus</i>	<i>Turraea robusta</i>
<i>Securidaca longipedunculata</i>	<i>Tarenna graveolens</i>	<i>Uvariadendron anisatum</i>
<i>Senna singueana</i>	<i>Teclea nobilis</i>	<i>Vangueria infausta</i>
<i>Sesamothamnus rivae</i>	<i>Teclea simplicifolia</i>	<i>Vangueria madagascariensis</i>
<i>Sesbania sesban</i>	<i>Teclea trichocarpa</i>	<i>Vernonia amygdalina</i>
<i>Spathodea campanulata</i>	<i>Teclea villosa</i>	<i>Vernonia auriculifera</i>
<i>Sterculia africana</i>	<i>Terminalia brownii</i>	<i>Vitex doniana</i>
<i>Sterculia stenocarpa</i>	<i>Terminalia mollis</i>	<i>Vitex keniensis</i>
<i>Stereospermum kunthianum</i>	<i>Terminalia orbicularis</i>	<i>Vitex payos</i>
<i>Strombosia scheffleri</i>	<i>Terminalia parvula</i>	<i>Warburgia ugandensis</i>
<i>Strychnos henningsii</i>	<i>Terminalia prunioides</i>	<i>Ximenia americana</i>
<i>Strychnos madagascariensis</i>	<i>Terminalia spinosa</i>	<i>Xymalos monospora</i>
<i>Strychnos mitis</i>	<i>Thunbergia guerkeana</i>	<i>Zanthoxylum chalybeum</i>
<i>Strychnos spinosa</i>	<i>Thylachium thomasi</i>	<i>Zanthoxylum gillettii</i>
<i>Suregada procera</i>	<i>Tiliacora kenyensis</i>	<i>Zanthoxylum mildbraedii</i>
<i>Synsepalum brevipes</i>	<i>Trema orientalis</i>	<i>Zanthoxylum rubescens</i>
<i>Syzygium cordatum</i>	<i>Trichilia dregeana</i>	<i>Zanthoxylum usambarense</i>
<i>Syzygium guineense</i>	<i>Trichilia emetica</i>	<i>Ziziphus abyssinica</i>
<i>Tabernaemontana johnstonii</i>	<i>Trichocladus ellipticus</i>	<i>Ziziphus mucronata</i>
<i>Tabernaemontana pachysiphon</i>	<i>Trilepisium madagascariensis</i>	