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FULL TITLE of REPORT/PROJECT	Development of a global strategy for the *ex situ* conservation of rice
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ABSTRACT *(Minimum 100 words)*	The primary source of information for the global strategy for the *ex situ* conservation of rice was a survey of rice genebanks conducted by IRRI during 2006-2007. The collated responses were analysed by an independent expert, Dr Kazutoshi Okuna, and developed into a draft strategy. At a workshop of experts in 2007,
KEYWORDS	Country/Region: Global Crop(s): *Oryza* sp., Rice Subject: *Ex situ* conservation, Rice genetic resources

Global strategy for the ex situ conservation of rice genetic resources

August 2010

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*This is not the food product commonly marketed in developed countries as “wild rice”; this is *Zizania* and is not covered by this strategy.

DISCLAIMER
This document, developed with the input of a large number of experts, aims to provide a framework for the efficient and effective *ex situ* conservation of cultivated and wild rice germplasm.

The Global Crop Diversity Trust ("the Trust") provided support for this initiative and considers this document to be an important framework for guiding the allocation of its resources. However the Trust does not take responsibility for the relevance, accuracy, or completeness of the information in this document and does not commit to funding any of the priorities identified.

This strategy document (dated December 2010) is expected to continue to evolve and be updated as and when circumstances change or new information becomes available.

In case of specific questions and/or comments, please direct them to the strategy co-ordinator, Dr Fiona Hay.

EXECUTIVE SUMMARY

1. INTRODUCTION

1.1 Why conserve rice germplasm?
About half of the world's growing population relies on rice as their staple food. In addition, rice cultivation provides the livelihoods for millions of people; it is grown in more than 100 countries and on every continent except Antarctica. It is predicted that the human population might reach up to 11 billion by 2050[1] and estimated that the world needs 8–10 million tons more rice each year (or an extra 1.5% per year) to meet people's needs and keep rice affordable[2]**.** In order to meet this growing demand, it is essential that rice scientists have free access to the entire rice genepool, including that of wild rice species, so that they can incorporate desirable genes into varieties that are evermore productive and/or tolerant of abiotic and biotic stresses.

1.2 Why cooperate globally to conserve rice germplasm?
It is self-evident that cooperating globally will result in more effective conservation and use at a global level.

However, the reality is that, outside of specific collaborative agreements, each rice genebank is independent of other rice genebanks in terms of management, mandate, finances, resources, and users. Each genebank has its own targets, which do not necessarily involve promoting effective conservation and use at a global level. National genebanks, for example, have national priorities. For a global rice strategy to be effective, it must also enable each individual member genebank to be more efficient and effective in meeting its own targets outside of the global strategy. Thus a key feature of this strategy is to facilitate globally effective conservation and use through empowering individual members to achieve their own targets efficiently and effectively.

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[1] Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2008 Revision, http://esa.un.org/unpp, January 25, 2010.
[2] IRRI. *Rice Science for a Better World.* www.irri.org

1.3 Development of the strategy

The process for developing the strategy was endorsed by the Council for Partnership on Rice Research in Asia (CORRA) at its meeting in Korea, 13-17 September 2004, and presented at the World Rice Research Conference of the International Year of Rice in November 2004.

The development of the strategy got underway with the implementation and completion of an initial pilot project on the Development of an Accession-level Information Resource for Rice between the International Rice Research Institute (IRRI) and the Malaysian Agricultural Research and Development Institute (MARDI; the holder of the Malaysian rice collection).

The process was discussed at the 5th International Rice Genetics Symposium in Manila, 19-25 November 2005.

A survey of information on the major rice collections around the world was undertaken in mid-2007 and an Expert Consultation Meeting was held at IRRI in December 2007 to discuss a preliminary draft prepared by Dr Kazutoshi Okuna.

The strategy document was completed and distributed for review in April 2010.

1.4 Objective of the rice *ex situ* conservation strategy

To have in place, following close consultation with relevant stakeholders, institutions, and networks, an overarching strategy that ensures the efficient and effective conservation of rice genetic resources globally and that will identify priority collections for support, upgrading, and/or capacity building. The strategy will promote the rationalization of conservation efforts at regional and global levels, for example, through encouraging partnerships and sharing facilities and tasks, and will link with relevant regional conservation strategies.

1.5 Definitions and usage

Working collection: A collection of germplasm maintained and used by a breeder or other scientist for their own breeding or research, without taking any specific measures to conserve. The collection may have a short life span and the composition of the collection may vary greatly during its lifetime.

Active collection: A collection maintained by a genebank and used as the source of seeds for active use, including distribution, characterization, and regeneration. It is usually conserved under short- or medium-term storage conditions.

Base collection: A collection of seed ideally prepared and held in ideal conditions for long-term conservation. The seed should be conserved and never used except for

i. periodic germination tests
ii. regeneration of samples conserved in long-term storage when their viability decreases below threshold
iii. regeneration to replace stocks in an active collection after accumulating 3-4 successive generations of regeneration from active collection and
iv. as the primary point of rescue when the accession is accidentally lost from all active collections.

Every unique accession in active collections should be safely conserved in well-maintained long-term storage, however not every genebank needs to maintain its own base collection.

Global system duplicate: An accession from one genebank duplicated in another genebank as part of the rational global system. The holder of the duplicate is responsible for the long-term conservation, management and global distribution of the duplicate sample including viability testing and ensuring adequate stocks. This provides security that unique germplasm is effectively conserved, an opportunity for improving efficiency by choosing the most appropriate genebank to satisfy a germplasm request, and an additional way to enable genebanks to participate in the global system even if they do not have the mandate or resources to distribute globally.

Safety back-up: Duplicate samples of the base collection, stored in a different genebank, preferably in a different continent. The storage conditions in the safety back-up should be at least as good as those in the corresponding long-term collection. The holder of the safety back-up has no rights to use or distribute the seed in any way or to monitor seed health or viability. Additional duplication of the base collection to the Svalbard Global Seed Vault provides definitive safety back-up in case of large-scale loss of crop diversity.

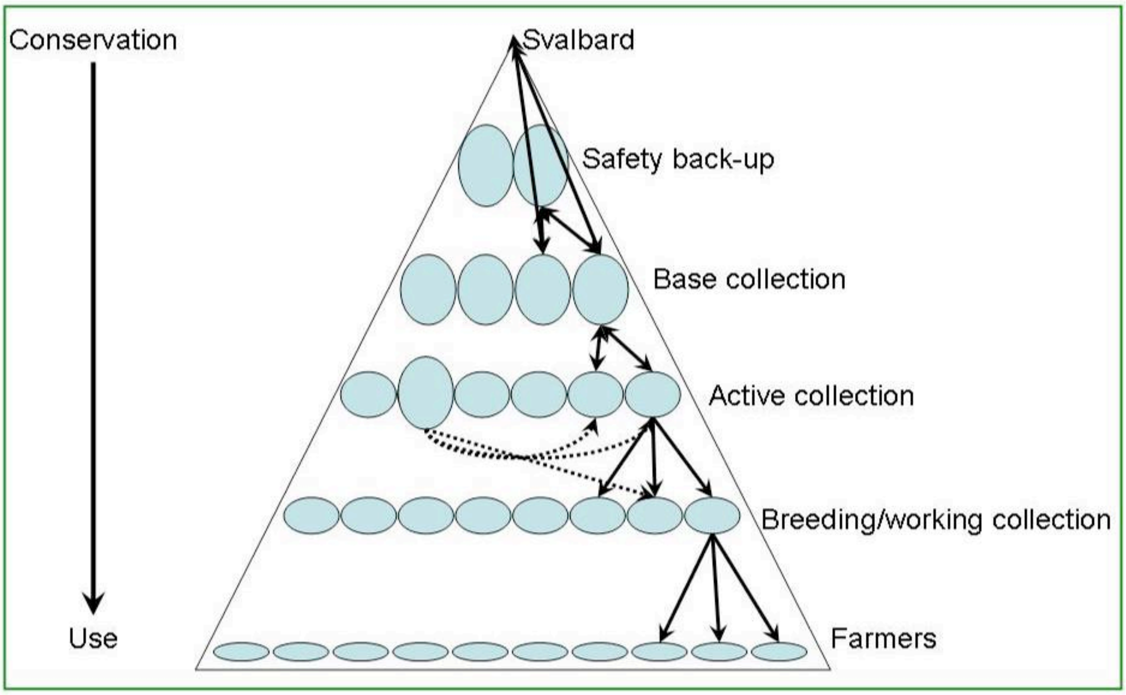
Seed file. A small sample of original seed, set aside when a seed sample first arrives at the genebank, to serve as the definitive reference sample. The seed file should be maintained dry under conditions preventing disease or pest damage, although not necessarily alive. Other seed samples of the same accession, *e.g.* for every new harvest, should be visually cross-checked with the seed file.

Most original sample. The living sample that is genetically the closest to the original sample. It should be kept under ideal conditions in long-term storage, and should not be used except for recovery in cases where the currently used sample is unacceptably different.

1.6 Framework for the global strategy

The general structure of the conservation and use of rice genetic resources in a rational, effective, efficient, global system, is illustrated in figure 1. The triangle links the ultimate in secure conservation (the Svalbard Global Seed Vault, or Svalbard for short) to the farmers who use rice genetic resources for food production, and provides a framework for assessing needs for collaboration and opportunities to improve efficiency and effectiveness.

Figure 1 Generalised illustration of the structure of a rational, effective, efficient, global system for the conservation and use of rice.



The apex depicts that we need only a single Svalbard, to provide the ultimate in secure conservation for all rice diversity. The broad base depicts the many millions of rice farmers who use rice genetic resources for food production.

The farmers are supported by rice breeders who build and use their own working collections to develop superior varieties of rice. Typically, a breeding programme targets a particular group of farmers – targeting for example by geographical region or agricultural ecology or market sector. Clearly the number of breeding programmes required is far fewer than the number of farmers to be supported. However, every country where rice production is a high priority should have its own rice breeders. Large rice-producing countries may have many breeders with many working collections.

Breeders in turn are supported by a smaller number of genebanks holding active collections. These genebanks differ in capacity and mandate. Smaller national genebanks may serve only local needs (indicated by the solid arrows from active collections to working collections). Other genebanks have a global mandate for conservation and use. They provide support globally, both by direct distribution to breeders and other scientists in any region, and by supporting the changing needs of genebanks with local mandate (dotted arrows in figure 1).

Management of these active collections should be optimised for efficient distribution to breeders or others who need access to novel diversity. The optimisation should include consideration of effective linkages to the users: there may be only one in a country even where rice production is important, provided it has effective links to all breeders in the country; but in large rice producing countries it may be more effective to have more than one active collection.

Active collections are supported in turn by a smaller number of base collections. These should be optimised for long term conservation, to help recover efficiently from the losses of genetic integrity that inevitably build up in active collections. Since the purpose of base collections is long-term conservation *ex situ*, not use, there are significant benefits to centralizing facilities. In an effective global system, only a small number of genebanks around the world should maintain base collections of rice.

Subsamples of all unique accessions should be deposited for security in a safety backup collection, preferably in a different continent under black box conditions. Very few genebanks are needed to provide this secure backup.

Finally, as noted above, further subsamples should be deposited for ultimate security at Svalbard. Since the primary safety backup collections should be under black conditions, seed for Svalbard should come direct from the holding genebanks, not from the primary safety backup.

2. BACKGROUND: THE RICE GENEPOOL

2.1 Cultivated rice

The genus *Oryza* has spread and adapted to diverse environmental conditions in tropical, sub-tropical and temperate regions around the world. The species are grouped into several "species complexes". *O. sativa* and *O. glaberrima*, the two cultivated species, belong to the "*O. sativa*" complex, together with six closely related diploid wild species of the AA genome group.

There are four major groups within the species, *O. sativa*:

- Indica rice, very widespread and diverse, primarily tropical; two subgroups, the Madagascar-Sri Lanka type and a second type found elsewhere.
- Japonica rice, less widespread and less diverse; two subgroups, tropical and temperate; the main group in countries such as Japan, USA, and Australia.
- Aus-boro rice of the Bangladesh region.
- Basmati-type rice from the Iran-Afghanistan-Pakistan-Nepal-N. India region.

O. sativa was domesticated around 6,000-14,000 years ago. Whether domestication began with a single or multiple independent events is the subject of debate. On the one hand, molecular dating suggests that the indica-aus and japonica-basmati forms separated about 2 million years ago, long before agriculture. Moreover, the two groups can be linked to different ecotypes of *O. rufipogon*. Therefore, it has been argued, they must have been domesticated independently. On the other hand, they share the identical mutant for non-shattering grains. Moreover, introgression between wild and cultivated forms of rice has been abundant throughout its history of cultivation, and continues now wherever wild populations grow in close proximity to crops. Thus domestication must be viewed as an ongoing process still continuing. Thus an alternative hypothesis suggests that there was a single original domestication event, and that the large differences between indica and japonica are a secondary consequence of subsequent introgression into different ecotypes of *O. rufipogon*.

Some suggest that the aus-boro types were domesticated independently of the indicas and that the basmati-types were domesticated independently of the japonicas. Tropical japonica corresponds approximately to what was previously classified as javanica rice. However, tropical japonica may well be a secondary hybrid swarm of indica introgressed into japonica. The boundaries between tropical japonica and indica or temperate japonica are ill-defined.

O. glaberrima was domesticated in West Africa more recently, from *O. barthii*, and is still cultivated only in comparatively restricted regions of Africa. The African species thus has relatively little diversity compared with *O. sativa*.

As *O. sativa* has spread around the world with farmers, it has, especially the indica form, differentiated into a great number and diversity of landraces which are an important genepool for rice germplasm enhancement. *O. sativa* reached Madagascar (through India) and Europe (through Greece and Italy, and subsequently Spain) over 2,000 years ago, and subsequently spread to other parts of Africa through Mozambique and to other countries of southern Europe. Secondary centres of distinctive indica-like diversity are particularly notable in Madagascar and Sri Lanka. More recent distinctive secondary centers of diversity are also apparent in Africa and the Americas. One of the most recent introductions, little over 100 years ago, is to Australia

2.2 Wild Rice

Currently, 24 wild species of *Oryza* are recognized (Table 1). Six species belong to the *O. sativa* species complex and have the AA genome. Eleven species are in the *O. officinalis* complex, five diploids with BB, CC and EE genomes, and six tetraploids with BBCC or CCDD genomes. The remaining species are more distantly related to the cultivated species, with genomes FF, GG, HHJJ and HHKK. The centres of species diversity and genomic diversity are the islands from Southeast Asia into the Pacific Ocean. Nine of the 24 wild relatives of rice occur in Indonesia, and 7 of the 10 genome types are found in the Asian-Pacific islands. In addition, distinctive sets of species assemblages are associated with South Asia, Africa and the Americas: each continent has its own set of wild species, and only one wild (*O. eichingeri*) is found in more than one continent.

Table 1. The distribution of wild species of *Oryza* (Source: Vaughan, 2003[1]; GRIN).

Species (genome)	**Country**
	Australian-Asian-Pacific species
meridionalis (AA)	Australia, Indonesia, Papua New Guinea
nivara (AA)	Bangladesh, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Sri Lanka, Taiwan, Thailand, Vietnam
rufipogon (AA)	Australia, Bangladesh, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Papua New Guinea, Philippines, Sri Lanka, Taiwan, Thailand, Vietnam
minuta (BBCC)	Papua New Guinea, Philippines
officinalis (CC)	Australia, Bangladesh, Brunei, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Papua New Guinea, Philippines, Thailand, Vietnam
malampuzhaensis (BBCC)	India
rhizomatis (CC)	Sri Lanka
australiensis (EE)	Australia
granulata (GG)	Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand
meyeriana (GG)	Indonesia, Malaysia, Philippines, Thailand
neocaledonica (GG)	New Caledonia
longiglumis (HHJJ)	Indonesia, Papua New Guinea

[1] DA Vaughan and H Morishima (2003). Biosystematics of the Genus *Oryza*. In: CW Smith (ed) *Rice: Origin, History, Technology, and Production.* Pp27-65. John Wiley & Sons, Inc.

Species (genome)	Country
ridleyi (HHJJ)	Cambodia, Indonesia, Laos, Malaysia, Myanmar, Papua New Guinea, Thailand
schlechteri (HHKK)	Indonesia, Papua New Guinea
African species	
barthii (AA)	Benin, Botswana, Burkina Faso, Cameroon, Central African Republic, Chad, Côte d'Ivoire, Ethiopia, Ghana, Guinea, Liberia, Mali, Mauritania, Namibia, Niger, Nigeria, Senegal, Sierra Leone, Sudan, Tanzania, The Gambia, Zambia, Zimbabwe
longistaminata (AA)	Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Côte d'Ivoire, Democratic Republic of the Congo, Ethiopia, Gabon, Ghana, Guinea, Kenya, Liberia, Madagascar, Malawi, Mali, Martinique, Mozambique, Namibia, Niger, Nigeria, Republic of the Congo, Rwanda, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Tanzania, The Gambia, Uganda, Zambia, Zimbabwe
punctata (BB)	Angola, Côte d'Ivoire, Democratic Republic of the Congo (formerly Zaire), Ghana, Kenya, Madagascar, Mozambique, Nigeria, Republic of the Congo, South Africa, Sudan, Swaziland, Tanzania, Togo, Zimbabwe
schweinfurthiana (BBCC)	Angola, Benin, Cameroon, Chad, Côte d'Ivoire, Democratic Republic of the Congo, Ghana, Madagascar, Mozambique, Nigeria, Republic of the Congo, South Africa, Swaziland, Zambia, Zimbabwe
eichingeri (CC)	Central African Republic, Côte d'Ivoire, Democratic Republic of the Congo, Kenya, Rwanda, Sri Lanka, Tanzania, Uganda
brachyantha (FF)	Burkina Faso, Cameroon, Central African Republic, Chad, Democratic Republic of Republic of the Congo, Guinea, Mali, Niger, Senegal, Sierra Leone, Sudan, Tanzania, Zambia
American species	
glumaepatula (AA)	Bolivia, Brazil, Colombia, Costa Rica, Cuba, Dominican Republic, French Guiana, Guyana, Honduras, Mexico, Panama, Surinam, Venezuela
alta (CCDD)	Belize, Brazil, Colombia, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru
grandiglumis (CCDD)	Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guiana, Paraguay, Peru
latifolia (CCDD)	Argentina, Belize, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, French Guiana, Guatemala, Guyana, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Surinam, Trinidad, Venezuela

Wild species of *Oryza* have proved to be an important source of genes that add value to the cultivated rice genome, with many already incorporated into commercial cultivars and many more under development. It is relatively easy to hybridise cultivated species with the six wild species in the "*O. sativa*" species complex with

AA genome; most species pairs show a degree of cross-fertility and produce fertile offspring. The AA genome species have been successfully used on numerous occasions as a source of important novel traits. These species may be considered to constitute the primary genepool. The eleven species of the "*O. officinalis*" species complex (diploid and tetraploid species with B, C, D, and E genomes) constitute the secondary genepool: they are more difficult to use, requiring embryo rescue to generate fertile offspring. The remaining seven species (with F, G, H, J, and K genomes) present considerable challenges, with low to zero rates of cross-fertility and low to zero rates of chromosome pairing between homoeologous chromosomes. They constitute the tertiary genepool.

Conservation of wild rice presents several additional challenges, reducing their ease of use but increasing the importance of implementing an effective, efficient, rational global system. Challenges include:

i. Several wild *Oryza* species are considered potentially noxious, invasive, or weedy and are subject to special biosafety regulations, rigorous control of movement, and require special containment facilities in order to grow them without risk to the environment. In some countries, weedy rice is a significant problem, reducing the yield of cultivated rice.
ii. Accurate identification of wild species is problematic, complicated by difficult taxonomy and extensive inter-specific hybrid swarms occurring naturally between sympatric species in the same species complex.
iii. Conservation and regeneration are more difficult because of low seed yields and shattering panicles. *O. schlechteri* must be maintained vegetatively.

3. COLLECTIONS

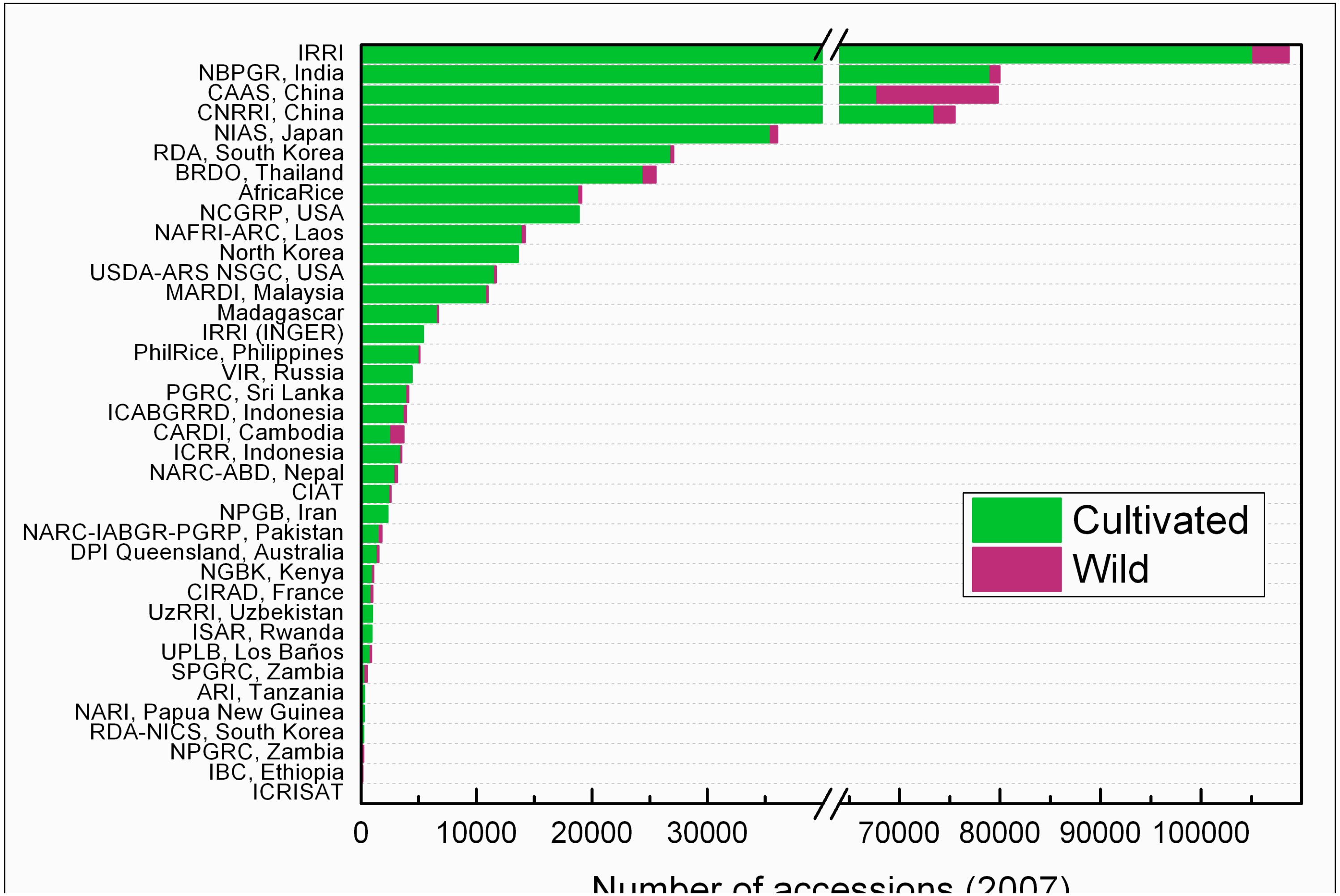
3.1 Overview of major collections

Over 500,000 accessions of rice genetic resources are conserved in international and national genebanks around the world (Figure 2). The majority are in only a small number of genebanks. The largest six genebanks are all in Asia, and together conserve around 70% of total world holdings. In order of number of accessions they are IRRI (CGIAR), the National Bureau of Plant Genetic Resources (NBPGR) in India, the Institute of Crop Germplasm Resources (CAAS) in China, the China National Rice Research Institute (CNRRI), the National Institute of Agrobiological Sciences (NIAS) in Japan, and the Rural Development Administration (RDA) genebank in the Republic of Korea. These genebanks hold well-organized long-term seed storage facilities.

The three largest collections outside Asia are in AfricaRice, the National Center for Genetic Resources Preservation (NCGRP) in the USA, and Brazil; but these collections are considerably smaller than the big Asian collections, and between them they hold only 10% of global holdings. The remaining 20% of global holdings are distributed across a large number of small national collections widely distributed through rice-growing regions of the world.

Accessions of wild rice are conserved *ex situ* in fewer genebanks, presumably because of the difficulties of their conservation and use. The largest collections of wild rice are at CAAS and CNRRI in China and at IRRI, with other significant collections at the Indonesian Center for Rice Research (ICRR), the Biotechnology Research and Development Office (BRDO) in Thailand, NBPGR India, and NIAS Japan.

Figure 2. Numbers of cultivated or wild rice accessions held at the institutes indicated (as at May 2007). Total number of accessions: 575,029.



3.2 Importance and uniqueness of the individual collections

The collections in IRRI, NIAS Japan, and USA (USDA-ARS; data not provided by NCGRP) have a broad global coverage, comprising mainly introduced accessions (Figure 3), probably a more temperate focus in Japan and USA compared with IRRI. The collections in China (CAAS and CNRRI) and NBPGR India are largely national in scope; both of these countries have conducted extensive in-country collecting missions, often without external collaboration, and therefore they are likely to contain a high proportion of unique germplasm. Most of the smaller collections are also largely national in scope; some of these have been undertaken in collaboration with international partners and are therefore duplicated outside the country, whereas others are not. Laos, for example, holds the largest collection of any developing country, but it is fully duplicated in IRRI.

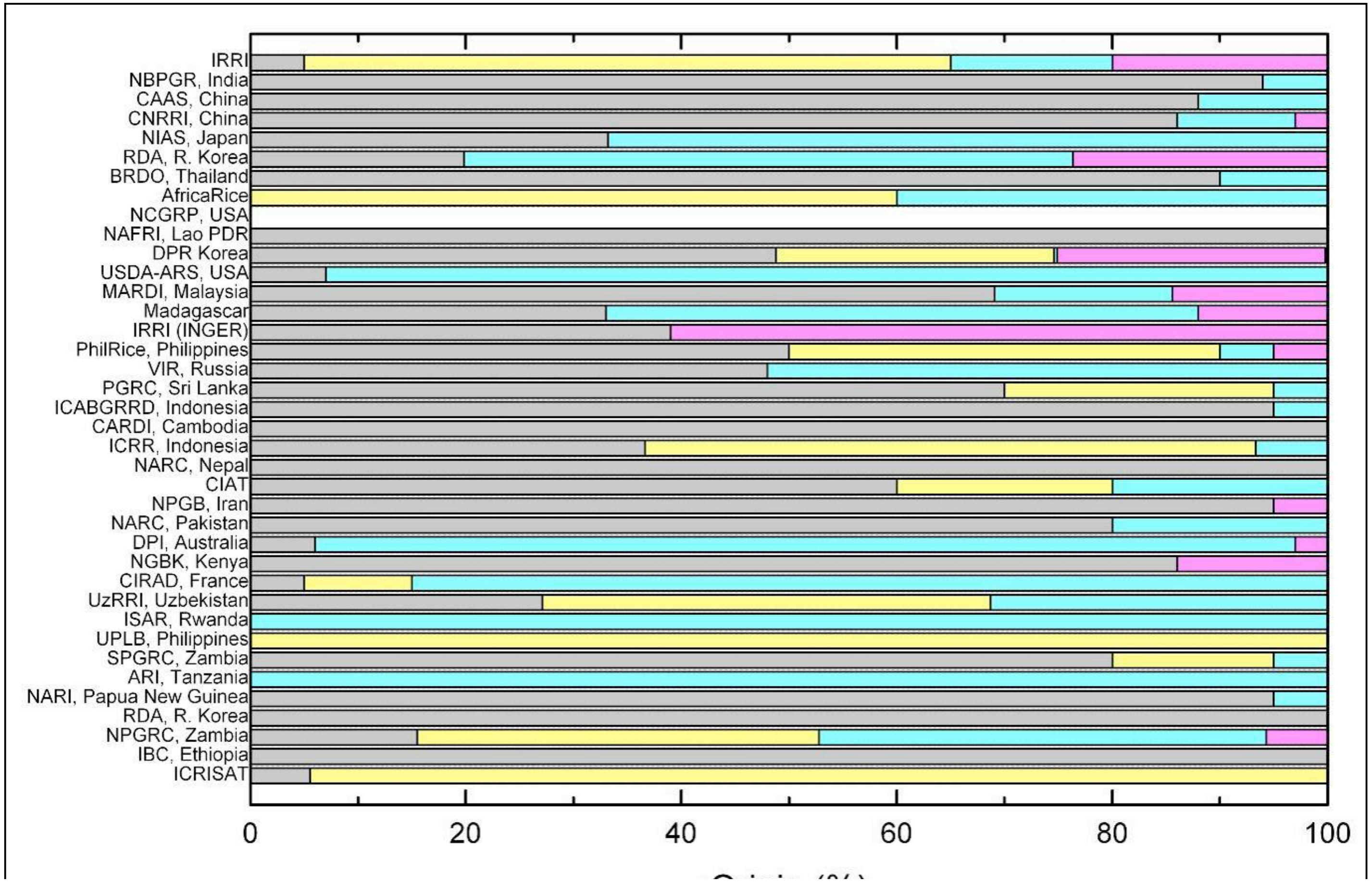
Beyond these broad statements, the extent of unintended germplasm duplication across the major genebanks cannot be identified with the available data. One of the undertakings of the GPG2 program[1] has been to develop a crop registry for rice, a cross-referenced database of accessions held across CGIAR and other major genebanks. This will start to provide some information on duplication, for a few of the rice holding genebanks, at least.

Although 70% of the world's holdings of rice accessions are in just 6 genebanks in Asia, this percentage probably does not provide an adequate indication of the relative need for support and rationalisation. The major national genebanks in Asia have been supported by the strong national programmes in each of the countries, commensurate with the high importance attached to rice in the region. By contrast, since rice generally receives lower priority in other regions, rice collections in those regions tend to be small, scattered and not well supported. This may indicate also a lower degree of integration and therefore possibly a relatively high level of uniqueness in these small national collections outside Asia. Therefore it may be desirable to focus a disproportionate effort on capacity upgrading for conservation, rationalisation and documentation in national genebanks in other Asian countries and other regions, at least to initiate the rice conservation strategy.

There are strong indications of gaps in coverage outside South and East Asia, especially in wild relatives of rice but also in cultivated rice. The absence of coordinated information makes it impossible to assess the extent of germplasm duplication or gaps, or to fully and rationally analyze the distribution of diversity or target the worst gaps.

[1] Rehabilitation of Global Public Goods in the CGIAR Genetic Resources Systems program phase 2 (2006-10, funded by the World Bank).

Figure 3. Origin of accessions held at the institutes indicated (surveyed May 2007).



3.3 Conservation status / genebank functionality

Ideally, genebanks that are distributing as well as storing and maintaining germplasm, should conserve the same material in both a base collection under long-term storage conditions and an active collection under medium-term storage conditions. Based on the responses to the survey (May 2007), the majority of the large collection holders have high proportions of their collections (70-100 %) under recommended long-term storage conditions[1], at least in terms of storage temperature (the survey did not specifically ask about seed drying facilities) although some e.g. CNRRI China, NIAS Japan, and BRDO Thailand are using a storage temperature of -10 rather than -18 °C (Table 2). The preferred storage container is laminated aluminium foil packaging.

Most of the Institutes with appropriate conditions for long-term storage, also have facilities for medium-term storage, although the conditions of storage are very much more variable between Institutes (Table 2). Further, the active collections of many Institutes are stored under conditions which fall short of those recommended for medium-term storage[2]. For example, medium-term storage conditions at NBPGR India are 7 ± °C and 35 ± 5 % RH. This is of less concern when the germplasm in the medium-term collection is also in the long-term collection. However, some Institutes, e.g. BRDO Thailand and NAFRI-ARC Lao, are storing significant, large proportions of their germplasm only under below standard medium-term conditions.

There are a few Institutes whose conditions for seed storage can be best described as suitable for short-term storage only (Table 2). Short-term storage may be sufficient for the purpose of those collections, as is the case for example, of the International Network for Genetic Evaluation of Rice (INGER, IRRI) which distributes rice lines amongst partners for evaluation under a variety of field conditions; lines are multiplied for distribution but not stored *per se.* However, there are other Institutes who may be holding unique germplasm under conditions where genetic erosion of those collections is inevitable due to a lack of appropriate drying facilities and/or temperature-controlled storage. Indeed a few Institutes, for example UzRRI Uzbekistan, ISAR Rwanda, and RDA-NICS R. Korea reported that the storage RH and/or temperature used at their facility depended on the ambient conditions.

All the Institutes that responded to the question about quality control (32 of 38 Institutes) indicated that there was regular monitoring (germination testing) of the rice germplasm. Of the remaining six, five did not respond to this question; this may not mean that they do not do any monitoring. A notable exception however, was ARI Tanzania who indicated that they do not carry out any quality control. Institutes that did not indicate that there are quality control measures also indicated that regeneration is not a routine procedure. However there were other Institutes that also indicated that regeneration protocols are not in place (e.g. ICABGRRD Indonesia and CIAT; Table 3).

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[1] Seeds should be dried to equilibrium with 10-15 % RH at 10-25 °C prior to storage at or below -18 °C for base collections (long-term storage) or at 2-4 °C for active collections (medium-term storage) [FAO/IPGRI (1994) *Genebank Standards*. Food and Agriculture Organization of the United Nations / Internatinal Plant Genetic Resources Institute, Rome.]

Table 2. Storage conditions used at the Institutes indicated (surveyed May 2007). In some cases where the main storage conditions indicated were not in accordance with international standards for long-term storage, the information has been entered under medium-term storage conditions.

		Long-term storage conditions				**Medium-term storage conditions**				**Short-term storage conditions**			
Institute	**Country**	**%**	**T (°C)**	**RH (%)[1]**	**Container[2]**	**%**	**T (°C)**	**RH (%)**	**Container**	**%**	**T (°C)**	**RH (%)**	**Container**
IRRI	CGIAR	100	-18		Vac Al-can	100	2-4		Al foil				
NBPGR	India	100	-18		Al foil		7 ± 2	35 ± 5	Various		20 ± 5	40 ±-5	Various
CAAS	China	100	-18	<50		40	-4 ± 2	<50					
CNRRI	PRO CHINA	100	-10	45	Al box	65	0 ± 2	55	Al box	15	17 ± 2	55	Glass box
NIAS	Japan	79.6	-10	30	Tin can	97.8	-1	30	Plastic	2.2	5		Plastic
RDA	R. of Korea	70	-18	40	Al foil	100	4	30	Plastic		4	30	Plastic, paper
BRDO	Thailand	50	-10		Al foil	90	5	60	PET				
AfricaRice	CGIAR					75	8		Plastic	25	18		Plastic
NCGRP	USA		-196 / -18										
NAFRI-ARC	Lao P D R	10	-18		Al foil	100	5	50	Al foil				
PCGRI	DPR of Korea					80	-5	55	Al foil	20	Ambient	60	Plastic
USDA-ARS	USA	95				100	6	25	Paper				
MARDI	MALAYSIA	70	-20	NA	Al foil	100	3-5	35-40	Al foil	30	19-21	50-60	Paper
FOFIFA	Madagascar	100	-20	>80%	Al foil	100	4-7	40	Al foil		6-18	60	Paper
IRRI-INGER	CGIAR									100	19-20	50	Plastic, Al foil

[1] Relative humidity may be that of the storage environment (e.g. freezer) and not the equilibrium relative humidity of the seeds.
[2] Vac Al-can = Aluminium cans sealed under vacuum; Al-foil = heat-sealed laminated aluminium foil bags.

PhilRice	Philippines	2	-20	30	Al foil	60	10	30	Al foil, paper, plastic	100	16	45-50	Paper/plastic in glass
VIR	Russia	92	-10	5-6	Al foil	8	4	Dry[1]	Al foil				
PGRC	Sri Lanka					100	1	25	Tin can	100	5	25	Al foil
ICABGRRD	Indonesia					100	5-8		Al foil	100	20		Paper
CARDI	Cambodia	100	-10 to -20	Si-dried	Al foil								
ICRR	Indonesia		0-5	85-90	Plastic, Al foil	100	20-26	80	Plastic	100	20-26	80	Plastic
NARC-ABD	Nepal									100	5-7	45-50	Paper
CIAT	CGIAR					20	15-20	40-50	Plastic	80	20-24	60-70	Paper, plastic
SPII-NPGB	Iran	100	-18		Al foil					80	0 - 5		Paper
NARC-IABGR	Pakistan	100	-20	Low	Al foil	40	10	40-50	Plastic				
DPI Queensland	Australia	100	-20		Al foil								
NGBK	Kenya	59.8	-20	18-20	Al foil	51.5	5	18-20	Al foil				
CIRAD	France	10	-18			90	18				18	40	
UzRRI	Uzbekistan									100	Ambient		Paper, linen
ISAR	Rwanda									100	Ambient	70	Paper
SPGRC	Zambia	72.5	-20	15-20	Bottles	100	-18		Al foil				
ARI	Tanzania									100	20-27	-	Paper
NARI	Papua New Guinea						10	n/a	Plastic, glass				
RDA-NICS	R. of Korea						15	Ambient	bottle		Ambient	Ambient	Paper
NPGRC	Zambia	100	-20	<10	Al foil								
IBC	Ethiopia		-100		Al foil		18-22	15-18	Glazed paper	100	40	35	
UPLB	Philippines									100	22	Ambient	Al foil, glass with silica
ICRISAT	CGIAR		-20	Ambient	Al foil	100	2	14.5	Al foil		15	15	Plastic

[1] Seeds dried to 5-6 % MC (interpretation of information given).

Table 3. Management procedures in place for the activities indicated (surveyed May 2007) and extent and location of safety duplication.

									Safety duplication	
Institute	**Country**	**Acquisition**	**Regenerate**	**Characterise**	**Store and maintain**	**Document**	**Health**	**Distribute**	**%**	**Location**
IRRI	CGIAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100	NCGRP USA
NBPGR	India	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0	None
CAAS	China	Yes	Yes	Yes	Yes	Yes	Yes	Yes	78	National genebank, China
CNRRI	PRO CHINA	Yes	Yes	Yes	Yes	Yes	X	Yes	73	CAAS China
NIAS	Japan	na[1]	na	na	na	na	na	na	na	IRRI
RDA	R. of Korea	Yes	Yes	Yes	Yes	Yes	X	Yes	48	Yeongnam Ag.R.I.
BRDO	Thailand	Yes	Yes	Yes	Yes	Yes	X	Yes	22	IRRI
AfricaRice	CGIAR	X[2]	Yes	Yes	X	X	X	X	26-56	IITA
NCGRP	USA	X	X	X	Yes	Yes	Yes	Yes	100	IRRI
NAFRI-ARC	Lao P D R	Yes	Yes	Yes	Yes	Yes	X	Yes	0	None
PCGRI	DPR of Korea	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0	None
USDA-ARS NSGC	USA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100	NCGRP USA
MARDI	MALAYSIA	Yes	Yes	Yes	Yes	Yes	X	Yes	32	IRRI
FOFIFA/CENRADER	Madagasc	Yes	Yes	Yes	Yes	Yes	X	X	12-	IRRI; NCGRP

[1] na=no response given for this section of the survey.
[2] X=response suggested this activity is not routine.

U	ar								21	USA
IRRI-INGER	CGIAR	Yes	Yes	Yes	Yes	Yes	X	X	49	IRRI
PhilRice	Philippines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	IRRI
VIR	Russia	X	Yes	Yes	Yes	Yes	X	Yes	71-100	VIR stations
PGRC	Sri Lanka	X	Yes	Yes	Yes	Yes	X	X	0	None
ICABGRRD	Indonesia	na	Na	na	na	na	na	na	100	IRRI
CARDI	Cambodia	X	X	Yes		Yes	X	X	35	IRRI
ICRR	Indonesia	X	Yes	Yes	Yes	Yes	X	Yes	57	ICABIOGRAD
NARC-ABD	Nepal	X	X	Yes	Yes	Yes	X	X	65-100	IRRI; MAFF Japan
CIAT	CGIAR	Yes	X	Yes	Yes	Yes	Yes	Yes	2	IRRI
SPII-NPGB	Iran	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0	None
NARC-IABGR	Pakistan	Yes	Yes	Yes	Yes	Yes	X	Yes	52-74	IRRI; NIAS Japan
DPI Queensland	Australia	Yes	Yes	X	Yes	Yes	X	X	0	None
NGBK	Kenya	Yes	Yes	Yes	Yes	Yes	X	Yes	12	IRRI; RBG Kew UK
CIRAD	France	Yes	X	X	X	X	X	Yes	NA	IRRI
UzRRI	Uzbekistan	X	X	Yes	Yes	X	X	Yes	0	None
ISAR	Rwanda	X	X	Yes	Yes	Yes	X	Yes	0	None
SPGRC	Zambia	na	na	na	na	na	na	na	0	None
ARI	Tanzania	na	na	na	na	na	na	na	0	None
NARI	Papua New Guinea	Yes	X	X	Yes	X	X	X	100	IRRI
RDA-NICS	R. of Korea	Yes	Yes	Yes	X	X	X	X	100	National Agrobiodiversity Center
NPGRC	Zambia	Yes	X	X	Yes	Yes	X	X	NA	IRRI; SPGRC
IBC	Ethiopia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	0	None
UPLB	Philippines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	50	IRRI
ICRISAT	CGIAR	X	Yes	Yes	Yes	Yes	X	Yes	0	None

Concerns relating to failure to monitor collections and/or to regenerate if there is declining seed viability are exacerbated if the germplasm has not been duplicated elsewhere. At the time of the survey there were 118361 rice accessions held at 12 Institutes (Table 3) which do not duplicate accessions elsewhere. Many other Institutes have not however, completely duplicated their accessions, and for those that have, the duplication location is not always, as recommended, on another continent.

The majority of the Institutes surveyed do acquire, characterize, document, and distribute rice germplasm. Apart from NIAS Japan who did not respond to this section of the survey, the Institute with the largest rice collection where these activities are not routine was WARDA (now AfricaRice) with 19066 accessions. Not counting INGER, other Institutes who at the time of the survey were not distributing rice germplasm were: FOFIFA/CENRADERU Madagascar (6681 accessions), PGRC Sri Lanka (4100), CARDI Cambodia (3691), DPI Queensland Australia (1514), NARI Papua New Guinea (260), RDA-NICS R. of Korea (213), NPGRC Zambia (209); SPGRC Zambia and ARI Tanzania did not give a response to this question.

4. EXISTING NETWORKS / PROGRAMMES

4.1 Effectiveness

The genetic diversity encompassed by the genus is the most remarkable among crop genetic resources. A total of over 500,000 accessions of rice genetic resources are conserved *ex situ* in many genebanks. The task of efficiently conserving and utilizing all the diversity of rice genetic resources is formidable and demands a global integration among multi-national efforts. However, most rice genebanks are working independently and ignorant of the achievements of other genebanks. There is not a specific, global rice genetic resources network. Bioversity International (formerly IPGRI), through regional offices, has been promoting regional networking of national genebanks. Their focus has tended to be on minor crops, however, there is a strong emphasis on rice in the Asian regional strategies.

In contrast to the absence of networks for the conservation of rice germplasm, INGER (http://seeds.irri.org/inger/) is an effective network of institutions in 80 countries collaborating in the maintenance, regeneration, exchange, evaluation and use of breeding lines, together with the associated passport and evaluation data. Created more than 30 years ago, it has always used an agreed multilateral system of access and benefit sharing (ABS). It has now adopted the ABS system of the International Treaty on Plant Genetic Resources for Food and Agriculture and all germplasm is exchanged with the Standard Material Transfer Agreement (SMTA) of the Treaty. It operates mainly through the distribution of pre-defined “nurseries”, or sets of germplasm selected on the basis of their perceived potential value for particular situations, e.g. drought tolerance, disease resistance, or qualities, e.g. aroma. Most of the materials distributed are advanced breeding lines and improved varieties.

In Africa, INGER-Africa has developed as an offshoot of INGER, operated by AfricaRice for the benefit of African countries.

In Latin America, FLAR (Fondo Latinoamericano para Arroz de Riego, the Latin-American fund for irrigated rice) has a similar purpose to INGER but is more restricted in genetic scope and in membership, geographic coverage, and germplasm sharing.

4.2 Potential

The crop-based strategy should be closely linked with the regional conservation strategy for strengthening the global rice conservation network. In particular, Asia is the most important region for conserving species diversity and genetic diversity of rice. More than 85% of global collections have been conserved *ex situ* in this region. The regional strategy in Asia prioritizes rice because of the importance for food security, sustainable agriculture and largest diversity and original collections. Upgrading capacity through the regional strategy may be more effective than upgrading through the global rice strategy.

On the other hand, rice tends to be a lower priority in other rice-growing regions such as Africa, Europe and Latin America. In these areas the regional strategies may be less effective for rice; moreover, as genebanks are less oriented to rice in those areas, gaps in coverage and deficiencies in conservation standards may also be greater. There may be a particular need to work on including these other areas in the global rice system.

Most existing rice germplasm exchange networks are aimed more at exchanging improved breeding lines for use in breeding and research, not for conservation of traditional varieties and wild relatives. For example, it may be appropriate to build on INGER's infrastructure for networking and for germplasm regeneration and exchange to facilitate the rice conservation strategy.

Any such network is ineffective without an effective information resource on which to base decisions and strategies. Indeed the lack of coordinated information is the major hindrance to the development of an efficient and rational global strategy for the conservation of rice genetic resources. Therefore, at the heart of the network there must be a global information system documenting, as far as possible, the relevant data of all accessions conserved in all participating genebanks.

5. THE GLOBAL RICE CONSERVATION STRATEGY

The strategy is intended to be an evolving program of assessment, prioritization, and action with respect to global rice genetic resources.

Key strategic targets are:

- Ensuring the global genepool is securely conserved, through
  - Rationally sharing conservation responsibilities
  - Raising capacity to conserve where necessary
  - Ensuring accessions are conserved in the right place, i.e. where it is most easily and effectively conserved and from where it can be effectively distributed.
  - Actions to fill gaps where necessary
  - Actions to regenerate threatened accessions
  - Identifying primary responsibilities for conserving the most original samples
  - Providing technical support where needed
- Ensuring the global genepool can be effectively used, through
  - A network of active collections maintained easily available for use, each collection closely linked to its target user community
  - Ensuring requests for germplasm are met from the most suitable genebank for the request
- Sharing and cross-referencing information to support joint actions and decisions.

Recognizing that genebanks differ in mandate, targets and resources, sharing responsibilities emerges as a potentially important tool to improve efficiency and effectiveness. For example, not all genebanks need to maintain? a long-term collection; and indeed in a rational global system the majority would not. It is therefore envisaged that genebanks in the global system should seek to collaborate by offering genebank services to other genebanks in areas of strength, or requesting genebank services from other genebanks in areas where they don't need it on site. The following are identified as genebank services which genebanks might offer to or request from others:

- Safety backup. Every genebank with unique accessions must make an arrangement with another genebank, preferably in another continent, to provide secure safety backup at least for its unique accessions.
- Long term conservation. Smaller genebanks should consider contracting out long term conservation to other genebanks. Genebanks with a primary mandate to support and promote use should consider not maintaining a long-term collection, and investing those resources instead in further promoting use.
- Active collection for regional or global distribution. Genebanks with a mandate to support local users should consider how they wish to respond to requests from other elsewhere. Rather than satisfying such requests directly, they may consider requesting another genebank to undertake such distributions instead, through a duplicate sample deposited at that genebank.
- Regeneration. Regeneration must be done in an appropriate location, in an environment suitable for the adaptation of the accessions. In addition, for wild rice, it is also essential to manage biosafety risks and to take additional

measures to control outcrossing. Thus sharing or contracting out regeneration can be essential for effective regeneration.

- Phenotypic characterization. While most genebanks would be expected to undertake at least characterization of simple traits, some characterization could be undertaken by others, particularly if it requires specialist equipment such as for grain quality measurements.
- Genotypic characterization. Although technologies for genotypic characterization are becoming more readily available, they still require specialist equipment and skills, and for many genebanks it may be more effective to contract it out.
- Georeferencing & GIS analysis. This is another area requiring specialist skills and equipment. Genebanks without the required expertise should consider contracting it out as an alternative to developing in-house capacity.
- Health & viability testing
- Information dissemination and access via the internet. Clearly the majority of genebanks should not invest separately in constructing independent mechanisms for searching their collections on the internet. The less duplication of programming effort the better. For further details see section 5.3
- Training & capacity building in all areas. There needs to be a coordinated system by which knowledge can be shared as necessary, through training and capacity building efforts.

In contrast, the following are identified as activities that must be undertaken by each genebank for itself, without possibility of contracting out to other genebanks:

- Data handling: data management for genebank management (for example, managing the inventory of seed stocks), correcting data, and providing data to users, must be done in-house. If the genebank does not have capacity to do so, it must develop the required capacity.
- Maintenance of active collection for national distribution. If a genebank cannot even maintain an active collection sufficient for national distribution, it is below minimum capacity to be an effective member of the global system.
- Participation in relevant networks and activities in the global system.
- Interaction & collaboration with institutional national users & stakeholders
- Training / raising awareness / obtaining commitment of institutional managers
- Engaging policy makers.

All members of the global rice strategy need to make decisions on services that they need or can provide. It is envisaged that the regional strategies will provide the best coordination of answers; thus further progress on this issue will rely on closer integration of crop and regional strategies.

Other than sharing responsibilities, in the first instance the strategy involves:

i. Rescue of threatened accessions by regeneration, currently being carried out with selected collections with support from the Global Crop Diversity Trust.
ii. Upgrading and maintenance support for selected genebanks.
iii. Improved documentation.
iv. Identification and filling of gaps in the conserved genepool and associated knowledge.

v. Increased efficiency and effectiveness, through collaboration and sharing of responsibilities.
vi. Co-ordination, including fundraising where required.

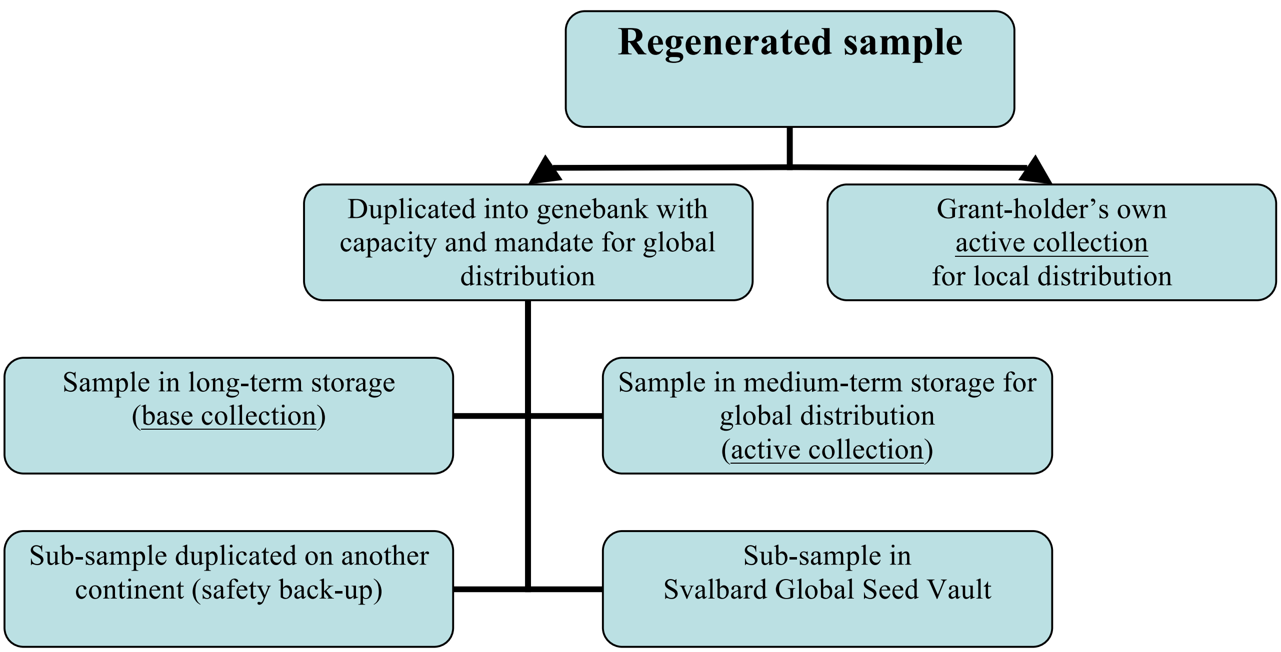
5.1 Rescue of threatened accessions

Nine countries have already been selected for support for regeneration, on the grounds that they hold unique samples that are not present in other genebanks and are under threat of loss because of inadequate conservation facilities: Indonesia, DPR Korea, Lao PDR, Madagascar, Nepal, Pakistan, Philippines, Russia, and Vietnam.

Others may be considered on the basis of responses to the rice questionnaire. Possibilities include ICRISAT, SPGRC Zambia, NPGRC Zambia, RDA-NICS R. Korea, and SPII-NPGB Iran.

In order to receive financial and technical support from the Trust, regenerated samples must be safely conserved in a quality genebank and available for distribution to others following the International Treaty on Plant Genetic Resources for Food and Agriculture (Figure 4). At the time of completing this document, duplicates samples have been sent from Madagascar, DPR Korea, and Pakistan for conservation in IRRI as part of the global system.

Figure 4. Schematic showing the destination of rice germplasm regenerated through grants given by the Global Crop Diversity Trust.



5.2 Upgrading and maintenance of selected genebanks

The process for identifying priority collections is still in progress. It must be undertaken in collaboration with regional strategies to gain the economic benefits of multi-crop genebanks.

5.3 Improved documentation

Management of data on genebanks must cover two distinct needs:

1. Data management for genebank management, i.e. a decision-support tool that helps genebank managers through their daily tasks of germination testing, health testing, inventory management, regeneration, characterization and distribution.
2. Data sharing for joint decisions. To enable rational joint decisions, shared data need to be up to date and with accessions fully cross-referenced to document the relationships between accessions in different genebanks.

Decisions on both these areas are pending. Both will require significant software development and significant upgrading capacity in many genebanks. The Trust is already funding the development of GRIN-Global as a genebank management system. If this is to become the genebank management system of choice for rice genebanks in the global rice strategy, there will be a need to review its interoperability with other advanced genebank management systems, such as IRIS-GRIMS developed and used by IRRI, and the systems developed and used by the national genebanks of Japan, Republic of Korea and China.

Sharing data for joint decisions will become a key element of the strategy, based for example on sharing responsibilities, directing requests to the appropriate genebank, and identifying unique / non-duplicate accessions / accessions with common ancestry. A partial "rice registry" has been constructed to help serve this purpose, cross-referencing rice accessions held in the USDA, CAAS-China, and the CGIAR (http://beta.irri.org/seeds/index.php?option=com_content&task=view&id=12&Itemid=64) . To serve its intended purpose in guiding globally rational decisions, this needs to be extended to include the other rice genebanks, and a mechanism needs to be established to ensure that it maintains up to date.

The rice registry is incorporated into the International Rice Information System IRIS (http://rice.generationcp.org/germplasm/), because IRIS has a fully generalised mechanism to document the cross-references and the type of relationships between accessions. Interaction between the GRIN-Global team and IRIS is encouraged to consider the potential for synergism, for example by exploiting the advanced germplasm-tracking facilities of IRIS.

5.4 Identification and filling of gaps

Identifying and filling gaps at a global level is seen as a key priority, but it will require a coordinated series of actions. These will include:

- Create a global rice registry to identify gaps
- Curate entries to establish, as far as possible, the correspondence between accessions held in different locations and the relationships between them
- Curate collecting location data to ensure accuracy
- Georeference all accessions with data on collecting location

Without georeferences, gaps may be identified only as far as the country, or possibly also province or district. With georeferences the gap identification can be based on full GIS analyses.

5.5 Increased co-ordination, efficiency, and effectiveness

Leveraging additional funds from other donors is envisaged as a key benefit of forming the global efficient effective system. Such additional funds would involve time-bound projects. Priorities identified during the startup workshop included:

- Phenotypic characterization and evaluation, facilitating better links to users.
- Molecular characterization, combined with gene discovery and allele mining.
- GIS-based analysis, also leading to better predictions of which accessions will be most useful for any user's needs.
- Promoting *in situ* conservation.
- Identifying gaps in the global collections and collecting to fill those gaps.

6. PROGRESS AS OF DECEMBER 2010

6.1 Regeneration projects

Financial support was provided by the GCDT to a number of Institutes whose rice collections were identified as being under threat due to inadequate facilities (Section 5.1). This support has funded the regeneration of accessions in country and the sending of samples from these regenerations to the TTC-GRC at IRRI (Table 4). Before samples are accessioned, those that are named varieties are checked (visual assessment) against the accession seed file in order to avoid undesired duplication. Where the sample size is too small for accessioning, the sample is first regenerated at IRRI (2010 and 2011 dry-seasons for samples from CIAT and NARC-Pakistan, respectively).

Table 4. Samples sent to the TT Chang Genetic Resources Center (IRRI) as a result of the GCDT Regeneration Projects.

Origin	Date received	Sample size received (g)	Number of samples	Number accessioned†	Number of duplicates
CIAT	Oct. 2008	30	1,635	None yet	524
FOFIFA, Madagascar	Aug. 2009	300	655	547	72
PCGRI, DPR Korea	Jun. 2010	100	1,437	1,084	No checking[1]
NARC, Pakistan	Jun. 2010	30	366	None yet	No checking[2]
TOTAL			**4,093**	**1,631**	

†Some may not have been accessioned due to duplication with existing accessions within the IRRI collection or because initial viability was below 85% (these have been / will be regenerated).

[1]Names only given as codes and therefore cannot be cross-referenced with existing accessions.

[2]Names not provided.

6.2 Safety back-up to the Svalbard Global Seed Vault

As of December 2010, safety duplicates from eight institutes had been sent to the Svalbard Global Seed Vault, amounting to a total of 135,978 accessions of *Oryza sativa* and other *Oryza* species.

6.3 Greater co-ordination

A significant step towards the rationalisation of collections held by different institutes was the Rice Register, one of the outputs of the System-Wide Genetic Resources Programme's Global Public Goods - Project 2. This involved comparing the accessions held at IRRI (TTC-GRC and INGER), USDA, AfricaRice, CAAS, CIAT, and IITA for samples that could be traced back to the same original sample collected *in situ* (e.g. from a farm, wild population, or market place) or to the same cross or breeder. The register also shows whether or not duplicates are likely to be exact; exact duplication is likely where accessions have been regenerated with minimal likelihood of loss of genetic integrity. Conversely, a duplicate is not exact if for example, the original sample was a mixture and only a selection regenerated for accessioning. The Rice Register can be accessed through the International Rice Information System (IRIS) at www.iris.irri.org.

The rice collections of AfricaRice, ILRI, and IRRI are already available to order by registered users through the 'one-stop' SINGER website (www.singer.cgiar.org).

6.4 GRiSP

The Global Rice Science Partnership (GRiSP) is one of the first research programs approved by the Consortium of International Agricultural Research Centers following its creation in April 2010. It represents a single strategic work-plan for global rice research and was put together by scientists at IRRI, Africa Rice, and CIAT in collaboration with Cirad, IRD, JIRCAS, and other research and development partners. It consists of six themes, the first being "Harnessing genetic diversity to chart new productivity, quality, and health horizons". The second product within this theme (product 1.1.2), recognizes that further action is required to improve the conservation of the global rice genepool and a key target is to improve co-ordination, within the context of this Strategy.

APPENDIX 1. SURVEY FORM SENT OUT TO GENEBANKS AND FORMING THE BASIS OF INFORMATION ON RICE ACCESSIONS USED TO DEVELOP THIS STRATEGY.

Increasing Efficiency and Effectiveness of Conservation of the Genetic Resources of Rice [1]
SURVEY

Background

The Global Crop Diversity Trust ("The Trust") is supporting efforts to develop strategies for the more efficient and effective conservation of crop diversity, particularly in *ex situ* collections. The Trust has commissioned the International Rice Research Institute (IRRI) to coordinate the development of a rice conservation strategy through an independent external consultant. This questionnaire has been developed in order to seek the advice and input of representatives of relevant stakeholders around the world in the development of the conservation strategy. In particular the questionnaire seeks to assess the status of rice conservation throughout the world.

If you curate a collection that includes accessions of rice, we please will you to complete all sections of the questionnaire. If there are no *ex situ* collections of rice in your institute, please complete sections 9-10 only. Please return the questionnaire to IRRI as soon as possible. IRRI will then compile all answers and forward them to the external consultant for analysis.

IRRI is keen to have your active participation in the development of the rice conservation strategy and will be pleased to keep you informed on its progress and consult you during the development until completion. If you have any questions about this questionnaire or about the proposed strategy in general, please contact r.hamilton@cgiar.org .

1. Organisation information:

Name and address of organisation holding/maintaining the rice collection	
Address:	
City:	
Postal Code:	
Country:	
Web site:	
Curator in charge of the rice collection:	
Name:	
Address:	
City:	

[1] For the purposes of this questionnaire and of the global rice conservation strategy, "Rice" includes all species of the genus *Oryza*, including the two cultivated (*Oryza sativa* and *O. glaberrima*), and all wild species. All of these are included in Annex 1 of the International Treaty on Plant Genetic Resources for Food and Agriculture.
Related genera, and the product sold commercially in North America as "wild rice" (*Zizania*) are not included because they are not in Annex 1 of the Treaty.

Telephone:	
Fax:	
Email:	
Name of respondent to this questionnaire if not as above	
Contact details:	
Date of response:	

1.2 Additional key contact persons for the above germplasm collections:

Name	Title/Function	Email Address

1.3 Please describe the organisation:

☐ Governmental organisation
☐ University
☐ Private organisation
☐ Other: please describe:

____

1.4 Is the institution in charge of the rice collection the legal owner of the collection?

☐ yes ☐ no

1.4.1 If no, who is the owner (including no owner identified)?

____

1.5 Is the collection subject to the terms and conditions of the International Treaty on Plant genetic Resources for Food and Agriculture? ☐ yes ☐ no

1.5.1 If no, is it expected to become under the International Treaty in the near future?

☐ yes, indicate expected date: ___________ ☐ no

2. Overview of the rice collection:

2.1 Main objective of the collection (long-term conservation, working collection, breeding collection)

____

____

2.2 Current size of the rice collection:

Type of germplasm (where known)	Number of species	Number of accessions	% available for distribution
Wild related species			
Landraces			

Obsolete improved varieties			
Advanced improved varieties			
Breeding/research materials			
Inter-specific derivatives			
Unknown			
Other, specify:			

2.3 Origin of the collection: please indicate the proportion (%) of accessions on the total amount that were:

	Percentage %
- collected originally in your own country (national origin)	
- collected originally in your own region (regional origin)	
- introduced from a collection abroad	
- from other origin (please define):	

2.4 Are there any major gaps in the collection?

Species coverage of the crop: ☐ yes ☐ no
Population (sample) representation per species: ☐ yes ☐ no
Ecological representation of the species: ☐ yes ☐ no
Other, please specify: ____

2.4.1 If yes, are there any plans to fill such gaps and if so please provide details on the plans.

____

____

2.5 What would you consider to be the most interesting aspects of your collection, making it unique?

____

____

2.6 Please describe the main potential/importance of your collection for use and breeding:

____

____

3. Conservation status (germplasm management):

3.1. Conservation facilities:

Please indicate the proportion of the accessions maintained under: (Note: if accessions are maintained under more than one storage condition the total percentage may exceed 100%)	**Percentage %**
Short-term storage conditions	
Medium-term storage conditions	
Long-term storage conditions	
Other, please specify:	

3.2 Storage form:

Please indicate the proportion of the accessions stored as:	**Percentage %**
Seeds	
Field accessions	
In vitro	
Cryopreservation	
Pollen	
DNA	
Other, please specify	

3.3 Please describe the storage facilities (if more than one, please use the different columns):

	Facility 1	**Facility 2**	**Facility 3 etc**
Type of facilities:			
Temperature:			
Relative Humidity (%):			
Packing material:			
Other, please specify:			

3.4 Have you established a genebank management system or written procedures and protocols for:

- ☐ Acquisition (*including collecting, introduction and exchange*)
- ☐ Regeneration
- ☐ Characterisation
- ☐ Storage and maintenance
- ☐ Documentation
- ☐ Health of germplasm
- ☐ Distribution
- ☐ Safety-duplication
- ☐ Other please specify: ______________________________

3.4.1 In case you have procedures and protocols, are you able to provide the Global Crop Diversity Trust with this information (i.e. provide a copy)? ☐ yes ☐ no

3.5 Please describe your quality control activities (in terms of frequency, protocols/methods and actions upon results):

Germination tests	
Viability testing	
Health testing	
True-to-typeness of *in vitro* plantlets	
Other, please specify:	

3.6 Is the collection affected by diseases that can restrict the distribution of the germplasm?

☐ yes ☐ slightly, only few accessions ☐ no

3.6.1 If yes or slightly, are knowledge and facilities available at your institution for eradication of these diseases? ☐ yes ☐ limited ☐ no

3.7 Please indicate the proportion (%) of the collection that requires urgent regeneration (apart from the normal routine regeneration):

Type of germplasm	**% of accessions with urgent regeneration need**
Wild related species	
Landraces	
Obsolete improved varieties	
Advanced improved varieties	
Breeding/research materials	
Inter-specific derivatives	
Unknown	
Other, specify:	

3.8 Please indicate the current and expected situations of the collection with respect to the following factors, where: 1 = high/good, 2 = adequate/moderate, 3 = not sufficient/bad, NA = not applicable:

Factors	**Current situation**	**Expected situation in 2010**
Funding for routine operations and maintenance		
Retention of trained staff		
Interest for Plant Genetic Resource Conservation by donors		
Genetic variability in the collection as needed by users/breeders		
Access to germplasm information (passport, charact., evaluation)		
Active support/feedback by users		
Level of use by breeders		
Other factors (please specify):		

4. Safety duplication (defined as the storage of a duplicate/copy of an accession in another location for safety back-up in case of loss of the original accession**):**

4.1 Are accessions safety-duplicated in another genebank? ☐ yes ☐ no

4.1.1 If yes, please specify:

Name of institute maintaining your safety duplicates:	Number of accessions	Storage conditions (short, medium, long term)	Nature of the storage (e.g. black box, fully integrated in host collection, etc.)
Add lines as necessary			

4.2 Is there any germplasm of other rice collections safety-duplicated at your facilities?
☐ yes ☐ no

4.2.1 If yes, please specify:

Name of holder of the original collection:	Number of accessions	Storage conditions (short, medium, long term)	Nature of the storage (e.g. black box, fully integrated in host collection, etc.)
Add lines as necessary			

4.3 To what extent do you consider the rice accessions in your collection to be unique and not duplicated extensively elsewhere (i.e. EXCLUDING safety-duplication)?

- ☐ Fully unique
- ☐ Mostly unique
- ☐ Partially unique
- ☐ Fully duplicated elsewhere

4.4 Are any constraints to duplicating the collection elsewhere outside your country?

☐ yes ☐ no

4.4.1 If yes, please specify.

____

5. Information management:

5.1 Do you use an electronic information system for managing the collection (data related to storage, germination, distribution, etc.)? ☐ yes ☐ partly ☐ no

5.1.1 If yes, what software is used?

____

5.2 Please indicate the proportion (%) of the following types of data is: (1) documented and (2) the proportion that is available in electronic format:

1. Type of germplasm	Passport data		Characterisation data		Evaluation data	
	Doc.	**Electr.**	**Doc.**	**Electr.**	**Doc.**	**Electr.**
Wild related species	%	%	%	%	%	%
Landraces	%	%	%	%	%	%
Obsolete improved varieties	%	%	%	%	%	%
Advanced improved varieties	%	%	%	%	%	%
Breeding/research materials	%	%	%	%	%	%
Inter-specific derivatives	%	%	%	%	%	%
Unknown	%	%	%	%	%	%
Other, specify:	%	%	%	%	%	%

5.3 In case the collection is not computerised, are there plans to do so in the future?

- ☐ No plans
- ☐ Computerisation planned within 3 years
- ☐ Other

5.4 Is information of the collection accessible through the Internet? ☐ yes ☐ partly ☐ no

5.5 Are data of the collection included in other databases?

- National ☐ yes ☐ partly ☐ no
- Regional ☐ yes ☐ partly ☐ no
- International ☐ yes ☐ partly ☐ no

5.5.1 If yes or partly, specify the databases:
____

6. Distribution and use of material:

6.1 What proportion (%) of the total collection is AVAILABLE for the following distributions?
Nationally: __________% Regionally: ___________% Internationally: __________%

6.1.1 Please fill in the number of accessions DISTRIBUTED annually, and indicate the expected change over the next 3-5 years, where: + = increasing 0 = no change - = decrease

	Number of accessions distributed annually (average of last 3 years)	Expected change for the next 3-5 years
Nationally		
Regionally		
Internationally		

6.2 Do you set specific conditions for distribution? Please specify:
____

6.3 Is the germplasm sufficiently available in terms of QUANTITY for distribution?
- Seeds: ☐ yes ☐ partly ☐ no
- *In vitro* material: ☐ yes ☐ partly ☐ no
- Cryopreserved material: ☐ yes ☐ partly ☐ no
- Other, please specify: ☐ yes ☐ partly ☐ no

6.4 Is the germplasm sufficiently available in terms of HEALTH for distribution?
- Seeds: ☐ yes ☐ partly ☐ no
- *In vitro* material: ☐ yes ☐ partly ☐ no
- Cryopreserved material: ☐ yes ☐ partly ☐ no
- Other, please specify: ☐ yes ☐ partly ☐ no

6.5 Do you have adequate procedures in place for:
- Phytosanitary certification? ☐ yes ☐ no
- Packaging? ☐ yes ☐ no
- Shipping? ☐ yes ☐ no
- Other, please specify: ☐ yes ☐ no

6.6 Do you keep records of the distribution? ☐ yes ☐ No

6.7 Which of the following received germplasm from you in the past 3 years?

Type of users:	**Proportion of total distribution %**
Farmers and Farmers' organisations	
Other genebank curators	
Academic Researchers and Students	
Domestic users	
Foreign users	
Plant breeders - public sector	
Plant breeders - private sector	
NGOs	
Others, please specify:	

6.8 How do you inform potential users about the availability of accessions and their respective data in your collection?

____

6.9 What are the most important factors limiting the use of the material maintained in your collection?

____

6.10 Please describe your policy regarding accessibility and distribution of rice germplasm:

Cost of accessions: ☐ free ☐ cost: ___________

Cost of shipment: ☐ free ☐ cost: ___________

Use of Material Transfer Agreement: ☐ yes ☐ no

6.10.1 Do you have any restrictions on who can receive materials? ☐ yes ☐ no

If yes, please specify: ____

7. Networks of rice genetic resources:

7.1 Do you collaborate in (a) network(s) as a rice collection holder?

☐ yes ☐ no

7.1.1 If, yes please provide the following information for each of the networks: (A) name, (B) type (national, regional or worldwide), (C) main objectives and (D) a brief description of the main reasons to participate in the network.

A- Name of network	B - National/ Regional/ Worldwide	C - Objectives	D - Reasons for participation

8. Major constraints:

Please list the 5 major limitations you are facing in the management of the collection:

1. ______________________________

2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________

9. Question concerning institutes NOT maintaining *ex situ* collections of rice:

If your institute does not maintain an *ex situ* collection of rice, please indicate to the best of your knowledge, the following:

Current conservation activities:	
Institute focal person to contact for further details:	
Plans for any *ex situ* conservation:	
Any other information:	

10. Please add any further comments you may have:

____
____
____
____
____
____

Please return the questionnaire to the International Rice Institute (r.hamilton@cgiar.org) as soon as possible.

APPENDIX 2. PARTICIPANTS OF THE WORKSHOP HELD 4-6 DECEMBER 2007.

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