Table 1a. Potential risks and management options for seed banks.

Activity	Risk Sources/Indicators	Risk/Consequence
	ACQUISITION	
Collecting	Narrow genetic variability and large gaps in germplasm collection	Failure to capture diversity in field
	Wide variability in flowering time and high shattering of wild types	Failure to capture diversity in field
	Low seed amount of new acquisitions	Genetic drift
	Untrained personnel in collecting and documentation	Failure to capture diversity in field and document important information
	Misidentification of germplasm	Misleading information
	Lack of simple collection protocol and documentation forms	Failure to capture diversity in field
	Agricultural intensification, replacement of traditional varieties with modern ones, urbanization, land use change, and climatic events	Loss of germplasm in habitat
	Strict country and international laws on access and use of germplasm	Poor access and use of germplasm in unexplored areas
	Breach of country and international treaties	Legal consequences. Damaged reputation and relationship
	Ambiguous position of countries regarding international treaties	Poor access and use of germplasm in unexplored areas
Donation	Received foreign materials carry pests and diseases	Introduction of pest and diseases to host country
	Limited seed testing capability	Restricts international germplasm exchange
	Reluctance to share germplasm due to IP rights	Restricts international germplasm exchange
	Working collections not duplicated in major genebanks	Failure to capture elite germplasm
	CONSERVATION	
Registration	Unverified passport and other data submitted	Incorrect or unreliable passport data, and subsequent reports
	Received materials have low viability	Loss of germplasm
Sample Processing	Culling of perceived offtypes that are true components of original sample	Loss of genetic integrity
	Non-removal of damaged seeds hence reducing true viable sample size	Drift and loss of genetic integrity from presence of unremoved damaged/weak seeds.

Activity	Risk Sources/Indicators	Risk/Consequence
	Inefficient fumigation	Drift and loss of genetic integrity from insect damage
	Lack of proper disposal procedures for contaminated plant materials	Dissemination of pests and diseases to new areas.
	Mixture from unclean mechanical threshers and selection of hardy grains resistant to mechanical threshers	Loss of genetic integrity
Storage	Misplacement of packets back into storage tray during briefings to visitors	Loss or misplacement of germplasm
	Underestimate of critical sample size	Loss of genetic integrity
	Ineffective packaging material and method permeable to moisture, pest or pathogen	Reduction or loss of viability
	Safety duplication site is vulnerable to natural calamities	Inaccessible or loss of safety duplication
	Changing policies, financial and technical capabilities of governments hosting safety duplication	Inaccessible or loss of safety duplication
Testing	Human error in taking and encoding weight readings	Incorrect moisture content data
	Defective weighing apparatus	Incorrect moisture content data
	Inefficient conduct of viability test and encoding	Overdue/backlog in viability test
	Human error in viability evaluation.	Incorrect viability score
	Dormancy	Incorrect viability score
	Unsuitable viability testing procedure for special types of germplasm	Incorrect viability score
	Inappropriate viability testing interval	Loss of viability
	Human error in seed health evaluation.	Pest incidence undetected
	Improper pest screening methods	Pest damage
	Defective pest screening equipment	Pest damage
	Untrained personnel in transgene detection	Loss of genetic integrity of other accessions
	Lack or improper determination of transgene presence	Inaccurate or wrong information regarding transgene presence
	Inadvertent spread of transgene in the collection	Loss of genetic integrity of other accessions
Regeneration	Poor field plot management	Loss of genetic integrity
	Misidentification of accessions	Loss of germplasm

Activity	Risk Sources/Indicators	Risk/Consequence
	Mis-roguing of true components of original germplasm	Loss of genetic integrity
	Differential pollen productivity of subtypes in highly heterogenous samples.	Loss of genetic integrity
	Cross pollination from other germplasm	Loss of genetic integrity
	Suboptimal pollination	Loss of genetic integrity
	Poor quality of harvest for storage	Loss of genetic integrity
	Different regeneration environment from the site of origin	Genetic shift or loss of genetic integrity
	Inappropriate location of genebank for regeneration of photoperiod-sensitive materials	Failure to produce new seeds
	Escape of non-native species into environment	Invasion of host habitat
	Endemic diseases from adjacent production areas	Loss of germplasm
	Unavailability of pesticides to control major insect pests due to strict regulations	Loss of germplasm
	Low germination of germplasm due to strong dormancy	Loss of germplasm
Characterization and Evaluation	Inefficient and erroneous data gathering and encoding	Backlog and inaccurate characterization data
	Descriptors that have no clear-cut correspondence to current international standard descriptors	No or limited usefulness of characterization data
	Limited text-based description	Incomplete and inaccurate morphological description
	Lack of diversity assessment of collection	Unknown level of breadth, duplication and gaps in collection, and conservation of unnecessary duplicates
DISTRIBUTION		
Policies	Lack of knowledge or negligence on seed exchange Protocol and International Treaty	Distribution without accompanying MTA. Inadvertent distribution of restricted germplasm (e.g. Non-MLS materials). Wrong information on the exchange status (MLS) of the germplasm.
	Recipients of “designated” germplasm or “non-designated” germplasm attempt to claim IP rights over the germplasm	Restrictions on future access and use of germplasm

Activity	Risk Sources/Indicators	Risk/Consequence
	Non-compliance with phytosanitary regulations	Germplasm distributed from genebank carry diseases or pest contamination.
Seed Preparation	Misclassification and wrong characterization and seed stocks data	Delayed identification and preparation of requested germplasm
	Inefficient and slow processing of requests for samples.	Dissatisfied recipients of germplasm
	Errors in preparing or labeling samples	Wrong germplasm distributed by the genebank
	Insufficient seed stock for distribution	Delay in serving seed request
Dispatch	Germplasm distributed with low viability	Dissatisfied recipients of germplasm
	Loss of documentation	Loss of important information about germplasm
	Unfavorable conditions during transport	Delay in delivery , reduction of viability or loss of materials
INFORMATION MANAGEMENT AND DISSEMINATION		
Labelling	Fading of labels and mislabelling of new bags and other containers for the germplasm accession	Wrong information on germplasm identity and inventory
	Misplacement of labels as seeds are laid out for drying	Loss of accessions
Data Handling	Inefficient recording and database management	Backlog and inaccurate characterization data
	Mishandling of information and disorganized data sets (e.g. information system, field/ lab observation)	Loss or inaccessibility of information
	Improper recording of moisture content, seed inventory, viability, storage location, and characterization data.	Inaccurate or wrong information
Back-up	Lack of secure back-up	Loss of genebank data
Data Quality	Inaccurate location of collecting sites	Misrepresentation of ecogeographic distribution
	Inadequate information about important traits of accessions.	Low interest and utilization of germplasm
	Human error in data gathering	Erroneous data

Activity	Risk Sources/Indicators	Risk/Consequence
	Important data and information remain in unuseful form.	Low level of utilization of germplasm and information.
Data Sharing	Slow availability of evaluation data for international users	Low interest and utilization of germplasm
	Limited ICT capability; server, network and IT related problems	Lack or poor accessibility of germplasm and important data to potential users
	Malfunctioning equipment, hardware and software problems, and power interruption	Failure to update data by genebank staff and damage to computerized database system
INFRASTRUCTURE/PHYSICAL FACILITY		
Functionality	Storage conditions at genebank not suitable (temperature, humidity, light conditions, exposure to contaminating organisms, pests)	Reduction or loss of viability
	Poor organization of storage trays, shelves and compartments	Loss or misplacement of germplasm
	Deterioration of facilities and equipment	Reduction or loss of seed viability
	Cold room malfunction	Reduction or loss of seed viability
Security	Power supply cut-off	Reduction or loss of viability
	Theft or vandalism	Loss of germplasm
	Environmental risks/weather elements, earthquakes, other catastrophic events (civil war,…), and fire	Reduction or loss of viability
PERSONNEL AND SUPPORT SERVICES		
Personnel	Inadequate complement of technical staff	Inefficient operations
	Incompetent staff	Inefficient operations
Working environment	Routine tasks and uncompetitive remuneration	Fast staff turnover
	Exposure to occupational hazards	Reduced manpower capability
Support Services	Inefficient human resources services	Delayed hiring of required manpower
	Inefficient purchasing and repair services	Delayed delivery/repair of required supplies and equipment
Financial	High cost of genebank operations	Loss of donor and user support