

Seed bank risk management

Technical Information Sheet 17

Introduction

Seed banks are fundamentally designed to conserve seed, be this for *ex situ* conservation, agricultural or forestry purposes. This technical information sheet focuses on the seed bank management of facilities primarily for wild species conservation (long-term storage). All seed collections have a value, be it their conservation and research value, or simply the cost to recollect. How much would it cost to recollect all the seed collections in your seed bank? Would this even be possible?

Ensuring that your seed collections are appropriately cared for and that anything with the potential to cause damage to the collections is addressed is a crucial aspect of seed bank management.

An important part of seed bank management is the creation of an emergency plan that contains a risk register. The risk register is a list of all the possible hazards that the seed



Figure 1: Above: Seeds stored at the Millennium Seed Bank (RBG Kew); Below: Flooded seed collections created in artificial intelligence (Dall-E).

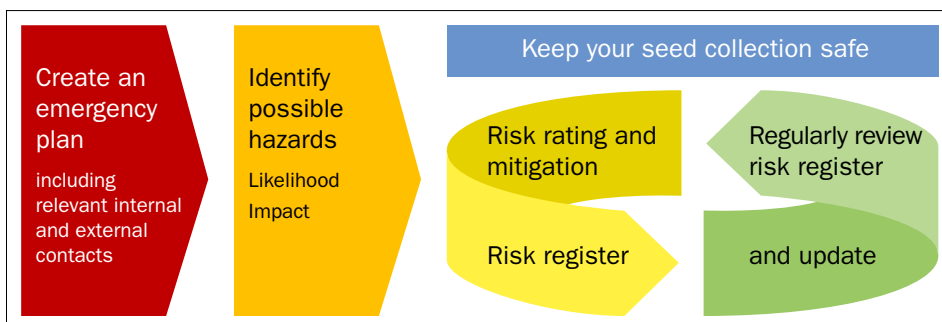


Figure 2: Flow diagram summarising the risk management process.

collections may face, their likelihood of happening, the likely impact were they to occur and any mitigation measures in place. The emergency plan adds further information on what additional measures can be put in place to help lower the risks to the collections.

Ideally, the safety of the seed collections should be considered as early as possible in the process of establishing a seed bank, no matter its size. Decisions about the location of the seed bank, equipment purchases, and operating procedures should be made by weighing risks together with other factors like access, cost etc. The earlier in the design process the risks can be identified, the more options there can be for addressing some of them.






However, it is never too late to create a risk register and emergency plan for your seed bank or any seed collections you hold. Equally, if you do not have a seed bank, but store seeds temporarily or handle seed collections, it is still important to have a risk register and emergency plan for your facilities. The risk register and emergency plan are meant to be dynamic and evolve with your seed bank as situations change over time. They should be reviewed regularly, especially if an event on your risk register happens.

This technical information sheet covers the general steps and guidance in how to identify risks and create a risk register and emergency plan. Box 1 outlines some of the key terminology.

Box 1: Definitions

Hazard	'Anything that could cause harm' ¹ . For seed bank management, this is anything that could cause harm or damage to the seed collection.
Risk	'A combination of two things – the chance the hazard will cause harm and how serious that harm could be' ¹ . For seed bank management, this is the chance the seed collections will be harmed and the seriousness of the harm to the collections, e.g. viability might decline, or the collections will be lost beyond repair.
Risk register	A method to identify possible risks that could affect the ability to undertake a project ² .
Emergency plan	A document which outlines the steps that are to be taken in the event of an emergency.
Duty manager	Person with responsibility to respond in the event of a hazard in a facility (in this case, the seed bank).
Equipment	Anything which plugs in to the building.
Facilities	Anything which is built into the building.
Mitigation	'A decision, action or practice intended to reduce the level of risk associated with one or more threat events, threat scenarios, or vulnerabilities' ³ .

Table 1: Summary of possible hazards which could impact seed collection quality within a seed bank. (Grouped according to categories of RIM Risk Management Initiative⁴)

Human 	Systems 	External environment 	Legal and compliance 	Processes 
Human error/ neglect	IT failure	Severe weather, e.g. flooding, storms, wind, drought	Third party exploitation of collections	Insufficient resources to maintain facility
Civil unrest	Power failure or power surges	Natural events, e.g. wildfires, earthquakes, lightning strike	Incorrect permissions to hold collections	Lack of staff training to use equipment and facilities
Terrorism	Mechanical failure	Pests, e.g. rodents, insects	Plant health & CITES	Maintenance of equipment by supplier
Theft/vandalism	Structural damage	Fire		Supply chain failure
Disease/epidemic (e.g. COVID-19)	Equipment failure	Aerial impact		
Vehicle impact with building		Burst water pipe or chemical leak/explosion/radiation incident		

Identifying the hazards

The first step is to identify all the potential hazards which might impact your seed collections. A hazard to the seed collection is any event which may result in the physical destruction or damage of the seed collection or negatively impact its longevity. The list of hazards should include all realistic events which may occur, even if it is unlikely that certain events would happen. When identifying hazards, it can be helpful to group them into categories. Table 1 shows some grouped examples of possible hazards to seed collections to consider.

Not all of these will necessarily apply to your seed bank facilities. There may also be other risks not on this list that should be considered.

Risk rating

A risk rating is calculated based on a hazard's severity and the likelihood of its occurrence. Hazard severity reflects how large a consequence the hazard could have on the seed collections were it to occur. Likelihood of occurrence reflects the chance of the hazard occurring, accounting for any existing mitigation strategies you may have in place. Table 2 shows how the hazard severity and likelihood of occurrence interact to determine the risk rating for each identified hazard. For example, a hazard severity of 'Moderate' and a likelihood of occurrence of 'Possible', combine to give a risk rating of 'Medium'.

Mitigating the risks

Once the risk rating process has been completed for each hazard, accounting for all current mitigations, if the risk rating is 'High', then further mitigations can be considered to reduce the risk to the seed collections if that hazard were to occur.

The mitigations for each hazard can be listed in a risk register. For the MSB, the risk register has been drawn up in a table, an excerpt from which is shown in Table 3. This table documents the type of event (i.e. the hazard), the main mitigations or procedures in place and any outstanding actions which need to be addressed.

For some types of incidents, the mitigating actions may depend upon

Table 2: Risk rating table

		Hazard Severity				
		Negligible Negligible impact on collections	Slight Minor impact on collections	Moderate Some collections may be put at risk	High Some collections harmed	Very High The majority of collections harmed
Likelihood of Occurrence	Highly likely Almost inevitable that an incident would result	Medium	Medium	High	High	High
	Likely Not certain to happen but an additional factor may result in an incident	Low	Medium	Medium	High	High
	Possible Could happen when additional factors are present, otherwise unlikely to occur	Low	Low	Medium	Medium	High
	Unlikely A rare combination of factors would be required from an incident to result	Low	Low	Low	Medium	Medium
	Highly Unlikely A freak combination of factors would be required for an incident to result	Low	Low	Low	Low	Low

the source of the hazard. For the hazard 'fire', there will be general mitigations for any fire event, but there may also be specific mitigations depending upon the cause of the fire (Table 3). For example, for any fire, general mitigations will apply, such as fire alarm systems and testing, familiarisation visits by the fire brigade, 24/7 security etc. However, for a fire due to an electrical circuit, a specific mitigation action of regular electrical testing of equipment would apply, whereas for a fire source of malicious activity, a mitigation measure would be to limit access to the seed vault. In this case, authorised access only to the vault wouldn't reduce the chance of an electrical fire, and regular electrical testing of equipment wouldn't reduce the chance of a fire due to malicious activity.

Some mitigation systems or procedures may be the same for different hazards. There are some mitigation actions which can have a significant impact, reducing risks across multiple potential hazards:

- **Duty manager**
See Box 1.
- **24/7 security or receptionist**
If possible, there should always be someone on-site who is able to initiate the emergency action plan in case of any event/hazard occurring. If this is not possible, alarms linked to mobile phones with on-call staff can be an alternative.
- **Staff training**
Whilst accidents and mistakes will always be a risk, appropriate staff training can help reduce the chance of this happening. In relation

to seed bank management, this could include training in chemical handling, use of seed bank equipment and facilities, seed bank procedures and protocols.

- **Good communication**
Ensuring phone or internet communication access is always available to those who need it means prompt actions can be taken if an event/hazard occurs.

Emergency plan

A risk register and the mitigating actions are a good way to describe and, to some extent, control hazards to your collections. Another element of managing your seed bank is your emergency plan. An emergency plan specifies procedures for handling sudden or unexpected situations to prevent staff injuries or damage to buildings, equipment or collections and to enable the return to normal operations as soon as possible.

The emergency plan may include a list of key people and/or organisations who should be contacted and their responsibilities (see Duty manager in Box 1). Within the organisation, this may include building or estate managers, health and safety officers and the plant health manager. External contacts could include fire services, nearest hospital and environmental agencies. An emergency plan should also establish legal responsibilities (for example, if staff safety is threatened by storm or disease, protecting them will take precedence over caring for the collections).

The emergency plan should be clear and concise, use simple language

and be easy to follow. As with the risk management plan, it should be regularly reviewed and updated.

Keeping the risk management plan up to date

Once you have your risk management strategy and emergency plan in place, it is important that it is regularly reviewed and updated. A risk management strategy is meant to be a dynamic document. For example, if one of the hazards in your risk management strategy occurs, you should consider the following:

1. Review how well the emergency plan worked, and the risk management documents and strategies can then be updated:
 - a. What went well?
 - b. What didn't go so well?
 - c. What could be done better if the hazard were to occur again?
 - d. Are there any other mitigation measures which could be put in place to avoid the hazard occurring again?
2. Is the rating of the risks identified appropriate?
 - a. E.g. Are there any additional mitigation measures you could put in place to lower the severity of the hazard were it to occur, or reduce the likelihood of occurrence? If there are, the risk management strategy can be updated.

Generally, it is recommended that the risk management strategy and emergency action plan are reviewed at least every six months and updated as necessary.

Table 3: Excerpt from fire section of the MSB main mitigation systems and procedures.

	Type of event	Main mitigation systems/ procedures	Comments and outstanding issues to be addressed
1	Fire: General	1) Independent fire alarm systems 2) Thorough testing of alarm system and evacuation procedures 3) 24/7 security 4) CCTV & door access control 5) Trained fire officers and wardens 6) Duty scientist system 7) Regular familiarisation visits by fire brigade	
1a	Fire source – electrical circuits (lights, power, CCTV, control panels)	1) Regular, documented electrical testing	
1e	Fire source – malicious activity	1) All vault areas are authorised access only, controlled by a door access system and monitored by CCTV 2) Heightened vigilance of staff when a risk is envisaged	

Summary

Risk management is an important part of keeping seed collections secure and we suggest using tools like risk registers and emergency plans to document and regularly review the best practices at your institutions. Individual risks and risk tolerance may vary depending on the location and nature of your collections, but the process can be usefully applied to different scenarios at any stage of projects, ideally from planning onwards.

References

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Case Study 1

Seed banking at the South African National Biodiversity Institute (SANBI) is helping to ensure the survival of South Africa's diverse plant species through long-term safe storage of seeds in case of loss in the wild and by providing seeds for ongoing species conservation and habitat restoration projects. Previously, collections were processed on-site and sent in full to the Millennium Seed Bank in the UK, but once

planning for the building work started for a National Wild Plant Seed Bank in South Africa, there were many factors to consider. One constant challenge was keeping the necessary equipment working during power outages. Certain equipment is needed to maintain the low humidity and temperature conditions that are necessary for long-term seed conservation, which was made difficult by the frequent power outages in South Africa – locally called load shedding.

As the duration of the power cuts vary, a solution was needed to mitigate this risk and provide a stable and reliable electricity supply for the seed bank, enabling it to remain functioning during any power outages. The new seed bank will have a dedicated back-up generator which will supply power to the seed bank, staff facilities and store room in the event of a power cut, with an automatic start-up switch activating the generator when detecting a loss of mains power. The generator includes a large diesel tank that allows for at least 50 hours of uninterrupted power, if needed.

Including and addressing risk factors at the planning stage can be crucial to maintaining the safety and quality of collections.



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New generator and some of the buildings it will supply power to at the Kirstenbosch Botanical Garden, South Africa.

Case Study 2

Millennium Seed Bank (MSB) during the COVID-19 pandemic

In the UK, when the COVID-19 pandemic hit, the UK Government ordered a nationwide lock-down. This meant only those classified as 'key workers' were allowed to go to work. In addition to this, social distancing was introduced, meaning everyone had to stay two metres apart. Overnight, the staffing and workflows in the MSB had to change. New practices were needed to ensure that the seed collections were managed whilst not compromising staff safety. The emergency plan kicked in and an emergency planning group was set up, who met weekly. The emergency planning group worked out how to manage the business through the

pandemic. The group identified that key personnel were required at the MSB to look after the collections and germination tests already running, but this needed to be done within a COVID-19 safe environment.

An essential staff rota was implemented, which reduced the risk of staff contact while also ensuring that collections management could go ahead. Face masks were worn by staff, workspaces were rearranged and increased cleaning schedules were implemented. It was necessary to balance the needs of the collections with the need to keep staff safe, both from COVID-19 infection and from risks caused by lone working. Due to the pace at which government guidance changed during this period, the seed collections team had to trust

each other, avoiding putting others at risk. While the capacity of the seed bank to process collections was reduced during the pandemic, work never stopped. The emergency planning group continued to meet for two years.



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A member of the seed collection curation team wearing a face mask to protect against COVID-19.