SPGRC

Genebank Review Report 2017

CROP TRUST

Review of SADC Plant Genetic Resources Centre Genebank

Program: Science & Programs	
Genebank reviewed: SPGRC	**Site visit dates**: 20 – 24 November 2017
	Review report date: 01 March 2018
	SPGRC and Crop Trust responses:
Place: Lusaka (Zambia), Gaborone (Botswana) and Réduit (Mauritius)	
SPGRC Director	Mr. Justify Shava
Reviewer	Ehsan Dulloo
Crop Trust staff	Paula Bramel

SPGRC 2017 Genebank Review: Recommendations and Responses

	Recommendations	Responses by SPGRC	Responses by Crop Trust
1.	SPGRC management should address a clear need for better coherence and collaboration within the organization. The reviewers recommend that the development of a common annual work plan for SPGRC with shared objectives that all programmes contribute to would lead to greater coordination and collaboration.	The SPGRC Management accepts this observation which is quite glaring and has contributed significantly to the majority of the challenges and shortcomings of the regional genebank. These are some of the measures SPGRC has taken to ensure coherence and collaboration in its programs (i) the Annual Work Plan is produced based on Revised RISDP 2015-2020; (ii) all programmes are tabled in one work plan to contribute to RISDP; (iii) you have joint weekly meetings with all the staff to revise what has been implemented the previous week and plan for the following week. The minutes are shared with FANR, and equally receives the information from FANR on weekly basis .	Crop Trust is in support of this recommendation and the steps being taken by SPGRC to improve the coordination within the organization and ensure that the genebank is managed under a common annual workplan.
2.	It is strongly recommended that SPGRC explore with SADC Secretariat and Member States to find a solution to funding required to enable the NPGRC and SPGRC curators' meeting to be held annually.	The meeting was not being held because of lack of funding. Since it is purely a technical meeting, curators who attend this meeting are supposed to be funded by the respective SADC Member States, according to SADC rules. Unfortunately some Member States are not funding their curators, resulting in the meetings being attended by a few curators or not taking place at all. SPGRC management is encouraging Member States to support the meeting through the Board members. The other possibility could be to combine this meeting with other regional programs like training workshops whenever they happen	Crop Trust is very supportive of the proposal that SPGRC hold member meetings on the back of other meetings, especially trainings. We agree that it is important that the network members contribute to the functioning of the network. Understandably it may not be possible to hold the meeting annually, but an attempt should be made to raise funding for a training/meeting periodically.
3.	It is recommended that SPGRC devise a performance monitoring system through a consultative process and agree on indicators with targets for both SPGRC and NPGRCs.	This suggestion is agreed and consultations have started and some targets have already been set such as number of collection missions done annually, number of accessions collected per mission, accessions characterised annually, accessions regenerated per year, etc.	Crop Trust agrees that it is good practice to identify targets. It would be sensible to harmonize indicators with those used in the Global Plan of Action and for the network to select a small number of key indicators (3-5) to which you can apply reasonable targets for the members to aim for. We would be happy to advise if helpful.
4.	It is strongly recommended that SPGRC implement of a Quality Management System	This suggestion is taken. SPGRC is considering having a QMS which will be extended to the NPGRCs by 2019.	Crop Trust agrees with this recommendation and response. Through the Genebank Platform, it

	(QMS) in order to ensure that processes are transparent and meet international standards. The development of a risk management strategy should be a key component of the QMS. We further recommend that the QMS is audited not only internally but also by outside experts.	It would be greatly appreciated if we could get some funding to engage international experts to help us develop a strong Quality Management System for our regional genebank and all the NPGRCs that will be internationally recognised.	may be possible for SPGRC to receive a QMS visit (or workshop) by the QMS specialist to help initiate this process. This will be considered for the 2019 calendar.
5.	The SPGRC QMS should be extended to all the NPGRC genebanks.	This is accepted.	Agreed, however significant funding would be needed to support more widespread implementation of QMS and having a deadline for 2019 does not seem realistic. Having said that, initial steps such as a QMS workshop for members could usefully help start the process. Also consider prioritizing those genebanks that are already able to support full-time staff and routine operations.
6.	It is recommended that SPGRC, in close collaboration with NPGRCs, carry out a study to identify the constraints that are preventing NPGRCs to safely duplicate all their accession at the regional genebank. Further a safety duplication action plan for the region should be agreed to reduce the risk of loss for national diversity conserved *ex situ*.	This is noted. A questionnaire was sent out where the NPGRCs have indicated that the limitation was lack of funding to multiply the accessions with small quantities so that they reach quantities that can be shipped to SPGRC and eventually to Svalbard Global Seed Vault. Others sighted lack of funding for payment of shipment itself to send the samples to SPGRC.	Crop Trust considers this to be one of the most important recommendations of the review. The SPGRC will be difficult to sustain as a network if it cannot provide basic support to ensure safety duplication of unique accessions in the region. We consider it essential that SPGRC considers carefully its *modus operandi* with respect to this point.
7.	It is recommended that the unique accession number issued by the donor NPGRC be maintained as the unique identifier for the germplasm. NPGRCs should be encouraged to apply for DOIs from the International Treaty on PGRFA.	This is noted for implementation.	The first point in the recommendation is extremely important for the management of the SPGRC genebank. The second point is very timely. It may be useful for SPGRC members to seek advice from the CGIAR genebanks and the Treaty Secretariat in implementing DOIs.
8.	The reviewers recommend a review of the policy for the routine replacement of freezers in the genebank so that it better matches the expected lifespan for the item. However, freezers should be constantly monitored and if found faulty, they should be replaced immediately irrespective of time.	Agreed. A replacement plan will be developed to reflect the number of freezers to be replaced over a period of time, and reflected in the annual plans and budgets.	Crop Trust supports the recommendation and response.

9.	It is recommended that a comparative costing study be commissioned to examine the long-term cost efficiency of using stand-alone cold rooms as opposed to the battery of freezers for long-term storage.	This is noted and will be implemented, according to resources availability.	Crop Trust supports the recommendation and response, and can provide advice if needed.
10.	The reviewers strongly recommend that SPGRC take all appropriate measures to significantly improve the security of the base collection. As recommended by Mr Obreza, the reviewers concur that a temperature sensor within each freezer be installed to record the temperature data using an online system. Other security measures such as installing a fire alarm in the genebank, repairing the air circulation tunnel, and improving the access control to the genebank are required urgently. These should be part of the risk management assessment and plan (see recommendation 4).	This recommendation is accepted. The SPGRC has sought for quotations for addressing the installation of the electronic freezer monitoring system. The cost indicator is that the system will cost +/- US$ 20 000. We urgently need this system and are, therefore, planning to budget for it. In the mean time, we are also appealing for donor intervention to quickly address this need. The SPGRC has now installed a fire suppression system in the gene bank with alarm systems. Since January 2018, a possible contractor for the repair of the air circulation system is being looked for.	Another very important recommendation. Crop Trust appreciates SPGRC's response and update on actions being taken. We suggest that SPGRC explores and inventories existing temperature monitoring solutions used by genebanks in the region and/or CGIAR genebanks to identify a cost-effective solution.
11.	It is recommended that SPGRC reviews its storage and packaging procedures to improve its storage space and its sustainability, paying particular attention to the following: a. All accessions be stored in aluminium bags in the future. For any new accessions to be banked, only aluminium foil bags should be used. For all the current accessions stored in bottles, SPGRC should develop a plan with annual targets to progressively transfer all accessions to aluminium foil bags. From a review of the store, it seems they have enough bags to start this transfer process. b. In the short term, higher quality, longer lasting labels should be used c. In the medium term, SPGRC should	This recommendation is accepted. SPGRC has already started migrating from the bottle system of storage to the aluminium system of packaging. Starting 2018, all the accessions received from Member States are now packaged in aluminium foil packets. The recommendation on labels will be implemented including the bar coding. SPGRC, however, requires support in purchasing the equipment to effect these good processes.	Crop Trust strongly supports the SPGRC response to the recommendation and actions being taken. For the short-term, current label printing technologies used in CGIAR genebank allow for printing long-lasting labels and procurement of such equipment is encouraged. For the medium-term, inclusion of barcodes on the labels requires a solid information system and should be postponed until such system (SDIS) is in place.

	adopt a system of bar coding for all the accessions in the genebank to increase thesecurity and cost-effectiveness for all processes in the genebank.		
12.	It is recommended that SPGRC should develop joint monitoring plans and coordinate the implementation of viability tests and regeneration of accessions with NPGRCs. Results should be exchanged between both parties and used as the basis for coordinate plans for accession regeneration.	This recommendation is noted for implementation. SPGRC will work with the NPGRCs to mobilise funding for conducting these programs.	Crop Trust supports this recommendation and proposes that SPGRC should attempt to explore the feasibility of coordinating viability testing and regeneration. Coming up with a coordinated plan across member states does not require financial support and may result in cost savings.
13.	To address the bottlenecks for multiplication and regenerations, it is recommended that SPGRC should: • Promote and facilitate the development of a regional regeneration plan, which would define the regeneration needs of NPGRCs, how regeneration could be done, and agree on who needs regeneration support; • Provide capacity building for NPGRC who needs technical support for regeneration of specific crops • Engage in a more active partnership with NPGRCs, CGIAR research sites in the region (such as ICRISAT or IITA), Universities, or the private sector, who have expertise and facilities to carry out regeneration collaboratively or on their behalf.	This recommendation is well taken for implementation. However, fund limitation may delay the development of the strategies and capacity building for the NPGRC staff. SPGRC is writing proposals though seeking funding to undertake these programs involving NPGRCs.	The Crop Trust considers that this recommendation is linked with recommendation 12. These recommendations point to the need for SPGRC to have a more intimate knowledge of how the member genebanks operate, what their needs and constraints are and the broad composition of their collections and to ensure there is an active exchange and follow up. Thus, the Crop Trust encourages SPGRC to explore the feasibility of coordinating regeneration more closely between members and seeking potential support from the CGIAR before it enters into a process of proposal development.
14.	It is recommended that a Data Sharing agreement between NPGRCs and SPGRC should be developed to facilitate and promote the sharing of characterisation (and other relevant) data.	This recommendation is accepted and will be factored in the amended MoU establishing the SPGRC which is under development. The MOU will be tabled for adoption by SADC Member States in August 2018.	Crop Trust supports the recommendation and response.
15.	The reviewers recommend that an in-depth audit of the number of accessions with	Agreed. The inventory of the accessions has already been completed at the SPGRC. This is now going to	Crop Trust supports the recommendation and response.

	characterisation data in the region be carried out, as a first step to prioritize and rationalize future work in this area.	be rolled out to the NPGRCs from May to August 2018. In the next planning meeting, countries will be requested to provide characterization progress data.	
16.	We concur with recommendations of Obreza (2015) to SPGRC to ensure that NPGRCs are supported in providing a common harmonised documentation and information system.	Agreed. The SPGRC has developed the Web Based SDIS which is being rolled out to the NPGRCs since 2016. It is not yet perfect but with further improvements, this system promises to efficacious. The roll out is expected to be completed by 31 March 2018.	The Crop Trust appreciates the inclusion of this recommendation and SPGRC's response.
17.	It is recommended that SPGRC review the costs, benefits and adoption rate of SDIS in the context of existing readily available options for genebank data management. If a decision is made to continue with the development and deployment of SDIS, the reviewers recommend that: • Documentation and Information Unit should work closely with SPGRC *ex situ* conservation programme for the effective deployment of web SDIS to the *Ex Situ* program and the NPGRCs and demonstrate SPGRC's capacity to "lead by example". • As a way forward for deployment, the web based SDIS should first be piloted by 2 to 3 selected genebanks (including SPGRC regional genebank) and that it is then gradually rolled out to other genebanks, accompanied by proper in depth technical support to the countries, to ensure that they are able to use the system. SPGRC Documentation and Information unit should serve as helpdesk and provide support to NPGRC in the use of SDIS. • A user manual, on-line training programme and helpdesk be developed for users to get better understanding of the web-SDIS. • Further, under the resource section of web	The SDIS is promising to be a useful tool for the region in the area of documentation of plant genetic resources. Like I indicated above, the system is not yet very perfect but with continuous improvement, it will be one of the best in the world. SPGRC has had some discussions with officers under the ITPGRFA's GLIS program who were impressed by the system. SPGRC plans to link the SDIS to other global systems through working together with institutions like the ITPGRFA. That Documentation and Information Unit and the Ex Situ Unit have to work together is accepted. SPGRC reports improved working relations between these two units and other units at the SPGRC. The web based SDIS development is already complete and the roll out to NPGRCs is also done in all NPGRCs although there is need for further technical support on its use. We also agree that SPGRC's Documentation and Information Unit must do more to serve as a help desk for the NPGRCs on the matters to do with the web SDIS and will put modalities to make sure it works this way. A manual for the web SDIS is under development and will be rolled out soon to users both electronically and on booklets. SPGRC accepts the need to have linkages with other systems about genebank management and platforms	The Crop Trust appreciates the response and actions SPGRC has taken in developing and promoting the new version of SDIS to members. We would like to stress the importance of "leading by example" and the need for SPGRC to provide support to member states in improving their genebank documentation systems – either by providing the on-line solution and helpdesk function, or by support in integration with their existing data management approaches. We would also point out that the online portal Genesys is a key component of GLIS.

	SDIS appropriate links to existing knowledge sharing systems about genebank management be established so that curators can get ready access to the literature, best practices, manuals, handbooks etc. • The list of scientific names follows the GRIN Taxonomy to obtain real time up to date taxonomic reference to the taxa. • An automated upload system into SDIS is provided to facilitate the inputs of data and other document types into web SDIS. • SPGRC organises the migration of existing data from old SDIS into the web SDIS. This could be done either by the developers of SDIS or SPGRC documentation staff. • In the storage data in web SDIS, information about the initial viability test be also provided. • SDIS only require a minimum mandatory list of passport data for germplasm registration.	for sharing literature and research on genebank management. The institution also wishes to share its experiences with fellow gene bankers on such platforms. The list of scientific names will be made to follow the GRIN Taxonomy. Information about initial viability of accessions will also be recorded in the web SDIS Minimum mandatory lists of passport data for germplasm registration will be developed. The migration of the existing data from the old SDIS to the new web SDIS has already been started and will be complete by end of March 2018.	
18.	It is recommended that SPGRC should further discuss its priorities in establishing a biotech laboratory and consider alternatives and partnerships for conservation of vegetatively propagated crops and genomics work.	The observation is that vegetatively propagated crop species are not being conserved well in the SADC region and there could be a lot of genetic erosion taking place within this category of plants. There is thinking within the region that more needs to be done to rescue these vegetatively propagated food crops in the region from extinction. The first step would be to develop field gene banks for these crops but there is also a need to explore the route of *in vitro* conservation as this will reduce the land limitations and cost of management as well as the threat of marauding pests and diseases. The SPGRC, therefore, requires a relatively simple tissue culture laboratory and storage facility to cater for the	Crop Trust supports the recommendation and understands SPGRC's response. It is clear from the above recommendations, that there are some basic and important operations and coordination activities that need to be supported as a priority if SPGRC is to effectively fulfil its role. Conserving vegetatively propagated crops requires a whole new spectrum of skills, facilities, processes, including intensive disease testing and cleaning. If SPGRC is to expand its scope into vegetatively propagated crops, it is our view that the priorities expressed in the first 17 recommendations need to be addressed and routinely supported first and before that expansion is attempted. In the

		vegetatively propagated crop species. Advanced genomics work is not a priority for now; as processes like fingerprinting can always be outsourced from the region and it looks like outsourcing is the cheapest option. SPGRC is appealing for support to build a simple tissue culture lab and capacity building of technical officers in tissue culture work.	meantime, as the reviewers suggest there are partnerships that could be set up with CGIAR Centres or other institutions to ensure that the major clonal crops in the region are conserved and made available at a global level.
19.	It is recommended that SPGRC prepare a Communication and Visibility Strategy and an Action Plan with a budget requirement to enable the centre to raise its visibility to the external world. As an immediate step, SPGRC should work closely with the public relations officer of FANR in SADC Secretariat and regularly send inputs to the Secretariat to report on their activities at the SADC level.	This is agreed. Communication and Visibility Strategy will be developed from April 2018. The strategy will include working closely with the FANR, Public Relations Unit at the SADC Secretariat and the SADC contact points in SADC Member States.	Crop Trust supports this sensible idea.

Review of SADC Plant Genetic Resources Centre Genebank

20th – 24th November 2017

Drs Ehsan Dulloo and Paula Bramel, Consultants

Executive summary

The review of the status of regional genebank and the collections of the SADC Plant Genetic Resource Centre (SPGRC),commissioned by the Global Crop Diversity Trust (Crop Trust),was carried out from 20th to 23th November in Lusaka, Zambia. A visit was made to the SADC Secretariat in Gaborone, Botswana on 24th November to meet with officials of the Directorate of Food Agriculture and Natural Resources. The reviewers also undertook an electronic survey of the depositors (i.e. National Plant Genetic Resources Centres (NPGRCs) in SADC region) and users of germplasm to get an insight of the level of satisfaction of the stakeholders of SPGRC as a network and users' access to germplasm conserved in SPGRC genebank.This report covers the main findings of the review based on information obtained from the field visits, reports that have been shared with the reviewers and meetings at SADC Secretariat and with three NPGRCs.

It is undeniable that the work that SPGRC is doing in the region is of utmost importance in securing the rich diversity of plant genetic resources in the SADC region that is a heritage not only for the region, but also for the world. The aim of the review was to assess the effectiveness and efficiency with which this important regional collection is being managed and to offer guidance to SPGRC, Crop Trust, and other stakeholders on how to improve the management and security of the collection. The review fully appreciates that there is a high recognition among the SADC member states of the importance of the work of SPGRC in the region in securing the plant genetic resources in the region and the willingness of SADC to continue to support the regional programme on plant genetic resources, after the 20-year project implemented through Nordic support ended.

The review team appreciates the need to revise the original Memorandum of Understanding for the establishment of SPGRC to bring it up to date. It is felt that one of the greatest strength of SPGRC is the support and facilitation of the regional network of national genebanks within the region (NPGRCs). However, the review team feels that the new proposed role and authority of the advisory Board is very much diminished for the proper management of the network. Also, the lack of the annual technical meeting, during which the curators of the NPGRCs can get together, will be detrimental to the good functioning of the network. The review strongly recommends that a curators' meeting be heldannually and be considered as a routine activity for the operation of the network.

The review also noted the decision of the Council of Ministers to expand the scope of SPGRC to include the conservation of animal and aquaculture genetic resource under their mandate. While it can be a good thing to bring under one umbrella all the work on genetic resources within the SADC region, it should also be mindful so as not overburden SPGRC when it is struggling to raise additional funds for its plant genetic resource programme.

The review noted that current management structure of SPGRC can be a hindrance for it to achieve its core mandate of securing the base collection of plant genetic resources on behalf of the SADC members' states. There needs to be greater collaboration between the three technical programmes to ensure that its objectives are met. The review also noted that there is no plan for staff succession in SPGRC. The replacement of all three of the senior programme officer at the same time, presents a challenge to the continued management of the regional genebank. Fortunately, the junior technical staffs have a long tenure of employment and are able to ensure the continuity of genebank activities. It is important that more investment in training of these junior technical staff are made to ensure that they are kept updated with the latest techniques of seed conservation and genebank management. It is proposed that the technical officer should benefit from short-term attachment to other well-developed genebanks to gain more experience.

The review, however, has revealed a number of key weaknesses that deserve attention from the management of SPGRC and SADC Secretariat to ensure that the regional genebank is

operating at the required international standards and to ensure the security of collections of germplasm that it is holding on behalf of the SADC member states. Four overarching concerns picked up by the review relates to the **security of the collection, quality of genebank operations, documentation system and effective collaboration and partnership**(both within SPGRC and with external partners). The review recommends that a full Quality Management System including a risk management plan and introduction of bar coding for the regional genebank and its NPGRCs be developed as a matter of priority to upgrade the performance of this important regional network and address itsshortfalls. The review has provided a number of technical recommendations to address weaknesses.

Visibility of the role and functions of SPGRC to the external world is fundamental for its long-term sustainability. The communication and awareness raising of SPGRC activities is devolved to the Documentation and Information Programme, which focuses on information technology and may not have the core competencies for communication and awareness raising. It is recommended that SPGRC should link with public relation officer of FANR in SADC Secretariat for helping to raise the visibility of the centre and the NPGRCs. There is a need to prepare a communication and visibility strategy and a costed action plan to enable the centre to raise itsvisibility, support, and use.

Reviewers Recommendations

RECOMMENDATION 1: SPGRC management should address a clear need for better coherence and collaboration within the organization. The reviewers recommend that the development of a common annual work plan for SPGRC with shared objectives that all programmes contribute to would lead to greater coordination and collaboration.

RECOMMENDATION 2: It is strongly recommended that SPGRC explore with SADC Secretariat and member states to find a solution to funding required to enable the NPGRC and SPGRC curators' meeting to be held annually.

RECOMMENDATION 3: It is recommended that SPGRC devise a performance monitoring system through a consultative process and agree on indicators with targets for both SPGRC and NPGRCs.

RECOMMENDATION 4: It is strongly recommended that SPGRC implement of a Quality Management System (QMS) in order to ensure that processes are transparent and meet international standards. The development of a risk management strategy should be a key component of the QMS. We further recommend that the QMS is audited not only internally but also by outside experts.

RECOMMENDATION 5: The SPGRC QMS should be extended to all the NPGRC genebanks.

RECOMMENDATION 6: It is recommended that SPGRC, in close collaboration with NPGRCs, carry out a study to identify the constraints that are preventing NPGRCs to safely duplicate all their accession at the regional genebank. Further a safety duplication action plan for the region should be agreed to reduce the risk of loss for national diversity conserved *ex situ*.

RECOMMENDATION 7: It is recommended that the unique accession number issued by the donor NPGRC be maintained as the unique identifier for the germplasm. NPGRCs should be encouraged to apply for DOIs from the International Treaty on PGRFA.

RECOMMENDATION 8: The reviewers recommend a review of the policy for the routine replacement of freezers in the genebank so that it better matches the expected lifespan for the item. However, freezers should be constantly monitored and if found faulty, they should be replaced immediately irrespective of time.

RECOMMENDATION 9: It is recommended that a comparative costing study be commissioned to examine the long-term cost efficiency of using stand-alone cold rooms as opposed to the battery of freezers for long-term storage.

RECOMMENDATION 10: The reviewers strongly recommend that SPGRC take all appropriate measures to significantly improve the security of the base collection. As recommended by Mr Obreza, the reviewers concur that a temperature sensor within each freezer be installed to record the temperature data using an online system. Other security measures such as installing a fire alarm in the genebank, repairing the air circulation tunnel, and improving the access control to the genebank are required urgently. These should be part of the risk management assessment and plan (see recommendation 4)

RECOMMENDATION 11: It is recommended that SPGRC reviews its storage and packaging procedures to improve its storage space and its sustainability, paying particular attention to the following:

a) All accessions be stored in aluminium bags in the future. For any new accessions to be banked, only aluminium foil bags should be used. For all the current accessions stored in bottles, SPGRC should develop a plan with annual targets to progressively transfer all accessions to aluminium foil bags. From a review of the store, it seems they have enough bags to start this transfer process.
b) In the short term, higher quality, longer lasting labels should be used
c) In the medium term, SPGRC should adopt a system of bar coding for all the accessions in the genebank to increase the security and cost-effectiveness for all processes in the genebank.

RECOMMENDATION 12: It is recommended that SPGRC should develop joint monitoring plans and coordinate the implementation of viability tests and regeneration of accessions with NPGRCs. Results should be exchanged between both parties and used as the basis for coordinate plans for accession regeneration.

RECOMMENDATION 13: To address the bottlenecks for multiplication and regenerations, it is recommended that SPGRC should:

- Promote and facilitate the development of a regional regeneration plan, which would define the regeneration needs of NPGRCs, how regeneration could be done, and agree on who needs regeneration support;
- Provide capacity building for NPGRC who needs technical support for regeneration of specific crops
- Engage in a more active partnership with NPGRCs, CGIAR research sites in the region (such as ICRISAT or IITA), Universities, or the private sector, who have expertise and facilities to carry out regeneration collaboratively or on their behalf.

RECOMMENDATION 14. It is recommended that a Data Sharing agreement between NPGRCs and SPGRC should be developed to facilitate and promote the sharing of characterisation (and other relevant) data.

RECOMMENDATION 15: The reviewers recommend that an in-depth audit of the number of accessions with characterisation data in the region be carried out, as a first step to prioritize and rationalize future work in this area.

RECOMMENDATION 16: We concur with recommendations of Obreza (2015) to SPGRC to ensure that NPGRCs are supported in providing a common harmonised documentation and information system.

RECOMMENDATION 17: It is recommended that SPGRC review the costs, benefits and adoption rate of SDIS in the context of existing readily available options for genebank data management. If a decision is made to continue with the development and deployment of SDIS, the reviewers recommend that:

- Documentation and Information Unit should work closely with SPGRC *ex situ* conservation programme for the effective deployment of web SDIS to the *Ex Situ* program and the NPGRCs and demonstrate SPGRC's capacity to "lead by example".

- As a way forward for deployment, the web based SDIS should first be piloted by 2 to 3 selected genebanks (including SPGRC regional genebank) and that it is then gradually rolled out to other genebanks, accompanied by proper in depth technical support to the countries, to ensure that they are able to use the system. SPGRC Documentation and Information unit should serve as helpdesk and provide support to NPGRC in the use of SDIS.
- A user manual, on-line training programme and helpdesk be developed for users to get better understanding of the web-SDIS.
- Further, under the resource section of web SDIS appropriate links to existing knowledge sharing systems about genebank management be established so that curators can get ready access to the literature, best practices, manuals, handbooks etc.
- The list of scientific names follows the GRIN Taxonomy to obtain real time up to date taxonomic reference to the taxa.
- An automated upload system into SDIS is provided to facilitate the inputs of data and other document types into web SDIS.
- SPGRC organises the migration of existing data from old SDIS into the web SDIS. This could be done either by the developers of SDIS or SPGRC documentation staff.
- In the storage data in web SDIS, information about the initial viability test be also provided.
- SDIS only require a minimum mandatory list of passport data for germplasm registration.

RECOMMENDATION 18: It is recommended that SPGRC should further discuss its priorities in establishing a biotech laboratory and consider alternatives and partnerships for conservation of vegetatively propagated crops and genomics work.

RECOMMENDATION 19: It is recommended that SPGRC prepare a Communication and Visibility Strategy and an Action Plan with a budget requirement to enable the centre to raise its visibility to the external world. As an immediate step, SPGRC should work closely with the public relations officer of FANR in SADC Secretariat and regularly send inputs to the Secretariat to report on their activities at the SADC level.

Purpose of the review

The purpose of this review is to assess the effectiveness and efficiency of the Southern African Development Community (SADC) Plant Genetic Resources Centre (SPGRC) regional genebank it its function to the SPGRC network across the region so as to determine the needs of the genebank for upgrading and for possible long-term support by the Crop Trust. The review will also seek to examine the status of individual collections managed by the regional genebank and the use of the material within the context of global system for the conservation and use of the crops in question.

The specific objectives of the proposed review of SPGRC regional genebank are to:

- Assess the capacity, operations, and activities of the genebank in the context of international standards;
- Assess the roles, services and use of the regional genebank, and the linkages with partners and users;
- Consider the status of genebank or individual collections within it, within the context of a global system for long-term conservation and use of the crops in question.
- Review the appropriateness of investment in the routine operations of the genebank;
- Provide actionable recommendations related to all of the above.

The review was carried out by Ehsan Dulloo (freelance specialist in conservation and use of plant genetic resources) and Paula Bramel (consultant of the Crop Trust), who visited SPGRC headquarter based in Chalimbana, Lusaka, Zambia from 20 to 23 November 2017, as well as the National Plant Genetic Resources Centre Zambia. A second external reviewerwas due to join the review team but could not attend due to delays in obtaininghis visa. Ehsan Dulloo also visited the SADC Secretariat in Gaborone Botswana on 24th November 2017 to meet with officials of Directorate of Food Agriculture and Natural Resources (FANR) and other divisions responsible for SPGRC. He also visited the NPGRC in Botswana and Mauritius.The Terms of Reference (TOR) of the reviewers are found in Annex 1.

Paula Bramel (consultant) facilitated the review for the Crop Trust. She provided background information, worked with the reviewers to develop the agenda, and coordinated the execution of the review on site. Given that the second external reviewer could not attend the visit, Paula stepped in to participate more actively in the review in Lusaka. In addition, she wasresponsible to oversee the completion of the final report. It should be emphasized that regular Crop Trust staff did not take part directly in the formulation of the review report and recommendations.

Methodology of the review

The review started with a desk study of background documents provided by SPGRCthat included the Memorandum of Understanding (MOU) for establishment of SPGRC, the MOU with CSIR, the MOU with IPGRI (Bioversity), Plant Genetic Resources for Food and Agriculture Policy guidelines (SPGRC, June 2013), the SPGRC Sustainability Strategy 2017-2027, the 2012 report on the SPGRC financial sustainability study, the Final report of the In-depth Review of the joint SADC /Nordic programme (Bagwe, Bjornstad and Lundgren, May 2006) as well as notes of the technical planning meetings, Board meetings and travel reports of Crop Trust to SPGRC in Zambia. The staff of SPGRC also produced a self-assessment report for the review.

The review team used the in-depth review of the joint SADC/Nordic programme carried out by Bagwe, et al. (2006) as a baseline for their review. The team also held detailed discussions with the SPGRC management team, technical staff, and administrative staff (Human Resources and Finance officers), during a site visit to SPGRC regional genebank in Chalimbana, Lusaka, Zambia from 20-23 November 2017.

The Head of SPGRC was not available during the site visit because he had to attend a meeting at the SADC Secretariat in Gaborone, Botswana.However, the consultantEhsan

Dulloo was able to travel to Gaborone to meet with him and with some officials of SADC Secretariat. Unfortunately,the head and most of the staff of Food, Agriculture and Natural Resources Directorate (FANR), which oversee SPGRC, were not available. The consultant met with Kathleen Molaodi, Senior Officer, Planning Monitoring and Evaluation (PPRM) and Mr Esaiah Tjelele, Program Officer Crops, Food Security Unit, FANR.

The reviewers also visited the Zambian National Plant Genetic Resources Centre (NPGRC). Ehsan Dulloo also visited the NPGRCs in Botswana and Mauritius. The review team also had a telephone conversation with the Board chair of SPGRC, Mr Godfrey Mwila.

Further, asurvey of the depositors (i.e. NPGRCs in SADC region) and users of germplasm was also carried out to get an insight of the level of satisfaction of the partners and users of SPGRC as a network and users' access to germplasm conserved in SPGRC genebank. Two questionnaires were prepared, one destined for SPGRC partners who are depositors of germplasm to SPGRC regional genebank as a safety back up. A second questionnaire was sent to users who have requested materials from SPGRC regional genebank. The list of users was provided by SPGRC. The results of the survey are given in Annexes 1 and 2. Annex 3 provides a brief account of the visits to the National Plant Genetic Resources Centres (NPGRC) in Zambia, Botswana and Mauritius.

The present report is therefore a summation of the desk study, survey results, the country visits, a tour of facilities and the discussion on site with SPGRC staff.The programme of the site visits in SPGRC and NPGRC in Zambia is given in Annex 4.

Establishment of SPGRC regionalgenebank

SPGRC and subsequently itsregional genebank were established in 1986 and 1989, respectively, as a result of the adoption of a 20-year strategy on agricultural research in SADC region under the Southern African Centre for Cooperation in Agricultural Research (SACCAR) and a 20-year project developed by IBPGR (now Bioversity).It was recognised that the establishment of a regional genebank would significantly contribute to the development of agriculture and forestry and help to increase the per capita input and output of the region. The Nordic countries accepted to fund the project on full funding during the first 10 years and joint funding with an increasing contribution of the SADC member states in the second 10-year period, such that at the end of 20 years, it would be fully funded by the members states. The 10-member countries signed a MOU establishing SPGRC in 1994. Since then, other countries in the region joined and currently 16-member states[1] form part of SADC, with Comoros Island recentlyjoiningSADC.It was argued that a common regional genebank with national support on a cost-sharing basis would be the most efficient option. Concurrently, NPGRCs were initiated in the Member States, which together with SPGRC form a well-coordinated network of genebanks for the region.By 2009, at the end of the funding from Nordic programme, SPGRC was taken under the aegis of SADC and continued to operate as a SADC programme, with its basic costs provided for by SADC Secretariat through contributions from member states.

The mandate and functions of the SPGRCaredefined in the Memorandum of Understanding establishing the SADC Plant Genetic Resources Centre signed by member states in 1993. This MOU is in the process of being revised. Some of the key functions of SPGRC relevant for this review include the following, among others:

- Hold the base collection of the member states;
- Maintain and manage medium to long term storage facilities for active collections of the member states;
- Make available in accordance with Article 15 of the Convention on all plant genetic resources collected and /or maintained at SPGRC or anywhere in the Region under the genetic recourse programmes, national or regional, to all bona fide users nationally, regionally or internationally;

[1] http://www.sadc.int/member-states/

- Acquire and exchange with NPGRCs relevant plant germplasm;
- Develop, maintain and manage the Regional Central Accession Database for the indigenous PGR of the member states – *ex-situ* as well as *in-situ;*
- Co-ordinate the inventory, collection, evaluation, rejuvenation and multiplication of indigenous genetic resources material of the member states;
- Keep records in a Regional Central Database of such introduced exotic plant genetic material as agreed to be of common interest for the member states;
- Prepare and issue catalogues of PGR available from or obtainable through the SPGRC;

In addition, SPGRC should also support NPGRCs to

- Gather, through exploitation and collecting expeditions carried out in the different ecological zones of the countries, information and material of PGR, of endemic and indigenous plants and exotic plants with a possible national evolution history, which are cultivated or used, or with a potential for cultivation or use, together with wild relatives of such species, and any species threatened with extinction;
- Characterise, evaluate, rejuvenate, multiply and document indigenous and exotic plant genetic resources material;
- Hold short term active collections of indigenous or exotic plant genetic resources material;
- Manage the in-situ and on-farm conservation, reserves and field genebanks;
- Work in close collaboration with national plant breeding institutions for effective and sustainable use of PGR.

The SPGRC regional genebank has been established to serve as a long-term base collection of the plant genetic resources of the member states of the SADC region. NPGRCs are responsible for collecting, processing and conserving their germplasm within their respective national genebanks and sending a duplicate sample to SADC regional genebank. NPGRCs are also responsible to multiply and regenerate their accessions.

The Crop Trust has collaborated with SPGRC to develop strategies for long term conservation of *exsitu* resources and to provide financial support for specific activities. The Crop Trust contributed to the improvement of seed drying facilities in the region and it also supported regeneration and safety duplication of regionally prioritized crop collections in specific countries in the region through a Letter of Agreement with SPGRCin June 2009. The Financial Sustainability Strategy of 2012 postulated that a more formal relationship with the Crop Trust would be particularly important since it confers global recognition of the collections and the duration of support could be expected to be on a long-term basis.

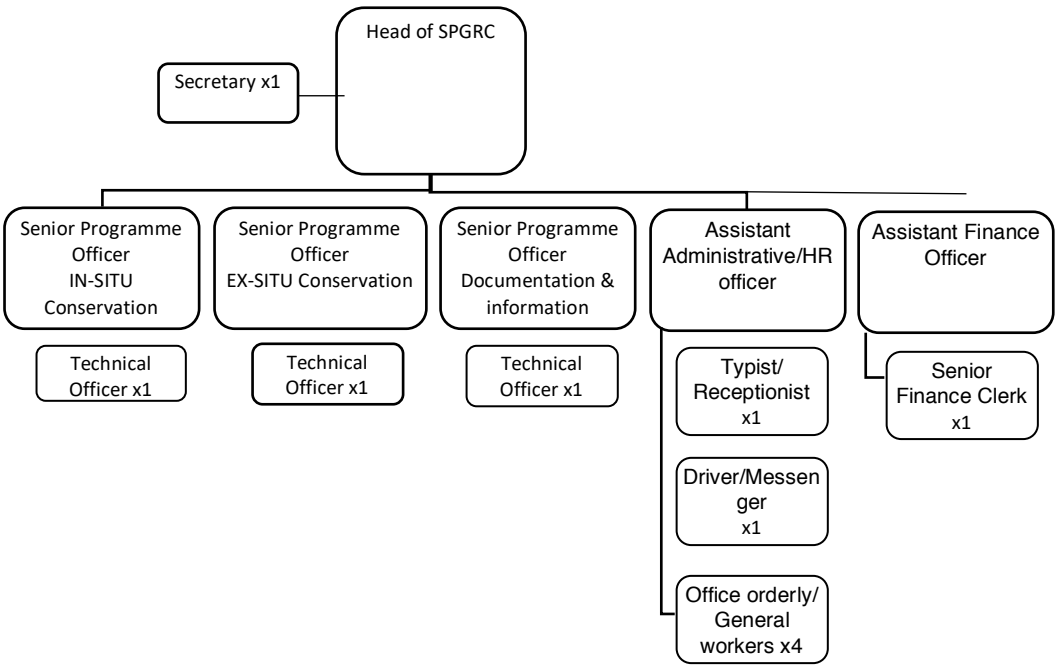
Management of SPGRC

Management Structure

The organigram of the SPGRC is given in **Figure 1**. SPGRC is led by the Head of SPGRC, Justify Shava, who joined SPGRC in July 2017. There are three programmes, namely *Ex situ* Conservation, *In situ*Conservation and a Documentation& Information,each headed by regionally recruited Senior Programme Officers (see Figure 1). Each programme has,in addition, one locally recruited Technical Officer. SPGRC have 7 general workers who report to the HR manager. They are allocated according the workload in each programme, but the general workers are also responsible for yard uptake (cutting grass), office cleaning, etc. In addition to 7 general workers, SPGRC also recruits casual labourers, but according to Zambian law these can only be employed for 2 months at a time.

There are also two support units – the Administration and Finance Units - that situnder the Head of SPGRC. The Administration unit is led by an Assistant Administrative/HR officer and has responsibility for human resources, procurement and administration of the office. The finance unit is led by an Assistant Finance Officer supported by a senior finance clerk.

Figure 1: SPGRC Organogram



The management of the genebank activities is coordinated by regular meetings of the senior management team, which is composed of the head of SPGRC, heads of the three technical programmes and support units. This provides a platform at SPGRC to coordinate the day-to-day activities and also to develop their work plans and budgets. At the beginning of the year each programme developsand submits a work plan and budget to SPGRC management.

The reviewers felt that the three programmes are functioning independently from each other, each with their own set of activities that relate to the genebank and conservation. Given that the primary responsibility of SPGRC is to ensure long-term conservation of the regional collection on behalf of its member states, it is imperative that activities in the three programmes should be geared towards this common objective. There needs to be a greater collaboration and coordination between the three technical programmes so perhaps the development of cross programme activity could help to smoothen the collaboration between them.

RECOMMENDATION 1: SPGRC management should address a clear need for better coherence and collaboration within the organization. The reviewers recommend that the development of a common annual work plan for SPGRC with shared objectives that all programmes will contribute to would lead to greater coordination and collaboration.

Governance

There are a couple of new developments that may affect the governance of SPGRC in the future. Firstly, the SADC Council of Ministers is considering the expansion of the scope of SPGRC to include animal genetic resources based on the infrastructure and experience gained by SPGRC in the area genetic resources. This measure may be desirable from a perspective of integration of genetic resource programmes including animal, aquatic resources, pollinators, microorganism and others, within the region to better ensure food security and meet the objectives of the SADC Regional Indicative Strategic Development Plan(RISDP) in having disaster preparedness for food security and access to food. However. the feasibility of implementing this measure without putting further burden on the SPGRC management is questionable, given that SPGRC is struggling in raising funds for its plant

genetic resources work, unless significant resources are made available to make this transition.

Secondly, with the replacement of the SPGRC Board by a Technical Advisory Committee (TAC), as proposed in the revised MOU for Establishment of SPGRC, with its new terms of reference, and the abolition of the Annual Technical Meeting, it is feared that the SPGRC network will lose its capacity to engage with the real technicians (i.e. the curators of the NPGRCs) who are the ones who plan and carry out the routine genebank activities. The new TAC will be represented by only 6 members states and include a financial and a legal expert. It is feared that having only 6-member countries on the TAC would not do justice to the network. Further mostly decision makers in the NPGRCs who may not be genetic resource specialists would beattending the TAC.

For the network to survive, it is vitally important to organizean annual curators'meeting to enable the technical staff to discuss problems, learn from experiences of their peers in other countries, discuss and share their individual work plans and plan cross regional activities. This is critical to make an effective network function with SPGRC leadership as the long-term conservation site. The Annual Curators' meeting was routinely held during the 20-year project funded by the Nordic programme which helped to create a strong PGRFA network in the region. However, after the end of programme, there were no funds to continue to hold the meeting. Between 2010 and 2017, the NPGRC curators could only be held twice in 2012 and 2015, thanks to funding from FAO. It is important that SPGRC is able to find the financial resources to hold the annual meeting. This was discussed with SADC secretariat and one option could be that annual meeting be held on a cost sharing basis, for example with SADC covering the cost of the meeting and NPGRC meet their travel expenses. This should be further explored by SPGRC with SADC secretariat and the member states. The review teamstrongly believes that such a meeting will help resolve a lot of the technical issues in the management of the national and regional collections and help raisethevisibility of the collection in the region.

RECOMMENDATION 2: It is strongly recommended that SPGRC explorewith SADC Secretariat and member states to find a solution to funding required to enable the NPGRC and SPGRC curators' meeting to be held annually.

Performance monitoring

While the SPGRC Board is responsible for the monitoring of the overall performance of SPGRC, there seems to be a lack of performance monitoring at the technical level. This also applies to the performance at the NPGRCs as well. There needs to be a mechanism for monitoring of genebank performance to ensure that the genebank is meeting international standards and achieving their goals. A set of key indicators with performance targets for the genebank both in terms of quantity and quality of operationsshould be developed and used by SPGRC management, Advisory Board, SADC management, and NPGRCs to ensure secure conservation. The Crop Trust has collaborated with the CGIAR genebanks to develop a performance monitoring system that is utilizes for all its long-term grantees. This system could be used as a basis for the development of a similar performance monitoring system for SPGRC and the NPGRCs.

RECOMMENDATION 3: It is recommended that SPGRC devise a performance monitoring system through a consultative process andagree on indicators with targetsfor both SPGRC and NPGRCs.

Finance

The core funding for SPGRC principally comes from SADC secretariat covering staff and operations for the genebank and technical cooperation with the NPGRC. According to the long term financial sustainability plan this cost covers the core activities of the SPGRC for maintaining the base collection (70%) and SADC expects SPGRC to supplement 30% of the budget through income generation activities from the farm and funded research projects. The annual budget of SPGRC is based on the 5-year strategic plan of SADC, which identifies the

key areas for interventions. Within SPGRC, each programme prepares their respective budget and a consolidated budget for SPGRC is submitted to the SADC Directorate of Finance and Policy (PPRM) for review. After approval by PPRM, the budget is submitted to the SADC Finance subcommittee. Member states will review the whole SADC budget including SPGRC's before final approval by the Council of Ministers. The finances of SPGRC are regularly audited by the SADC Secretariat, which makes reports on the financial situation to SADC Financial subcommittee and Council of Ministers. The SPGRC Board monitors the performance of SPGRC.

In addition to core funding from SADC, SPGRC seeks funding from other donors (International Cooperating Partners (ICPs)). Funding from ICPs needs to be approved by the SADC Secretariat and ultimately by the Council of Ministers, before it can sign any agreement with an ICP. SPGRC is encouraged to source extra funding for its activities. Currently SPGRC has no agreements with any ICP. The last donor funding was from the Crop Trust, which supported seed drying and regeneration activities.

Sustainability Strategy

The 2012 report on SPGRC financial sustainability discusses a number of avenues to source external funds from donor agencies, competitive research grants, endowment funds and contract research. It further recommended SPGRC to explore other international mechanisms and partnerships with possible players in the regions. In response to the financial targets set by the financial sustainability plan, SPGRC prepared a Strategic Plan (SPGRC, July 2016) to summarize the options and strategies for achieving the financial target, while taking care of the scientific and technical roles required for conservation and use of PGR (SPGRC,2016).

The review team agrees with the overall plans and strategies that SPGRC has set itself over the next 10 years. We think that a major priority should be to develop strategic partnerships with other SADC programmes and funding mechanisms that exist within the region. SPGRC is already hosting a staff member of the SADC Seed Centre (SSC) and providing financial management services to them. This hosting arrangement can provide increased opportunities to work closely and develop common projects linking the conservation of PGR to use of genetic resources in the region. Further it is suggested that SPGRC take proactive initiatives in linking with Centres for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) from which major funding for research can be made available for SPGRC.

Review of the routine operational procedures of the SADC Plant Genetic resources Centre Genebank

In this section we provide an account and review of the status of the facilities at SPGRC, current work flow in the SPGRC regional bank, and an analysis of the work flow in the regional genebank.

Description of the regional genebank

The physical infrastructures of the SPGRC regional genebankand other facilities ofSPGRC are excellent and are still adequateas described by Bagwe et al. (2006). The facilities at SPGRC are built on land provided by the Government of Zambia with a 99-year lease and include genebank, seed laboratories, stores, and seed processing room which also include the drying room, office spaces (for staff), conference room, library, staff room, kitchen, computer room, and bathrooms. In addition, the facility hasresidential houses for most of its regional staff and 22 ha of land of which 12ha are now under irrigation, compared to only 4 ha in 2006.Part of the land also has a field collection of tree species. It also has a meteorological station on site and daily temperature and rainfall readings are taken. SPGRC is also considering the establishment of a biotechnology laboratory for in vitro conservation and molecular analysis.

The genebank facility at SPGRC is in good condition. It has all the required storage equipment in good working conditions for seed processing and long-term storage of germplasm. The basic equipment at SPGRC include collecting kits, weighing scales, seed dryers, moisture testers, germinators, desiccators, bottle sealers, foil sealers, deep freezers and computers with common software. The genebank has 75 freezers and is currently operating at full capacity. A

new germinator has been purchased and is operational, although they are experiencing problem with the temperature control and the lighting elements.

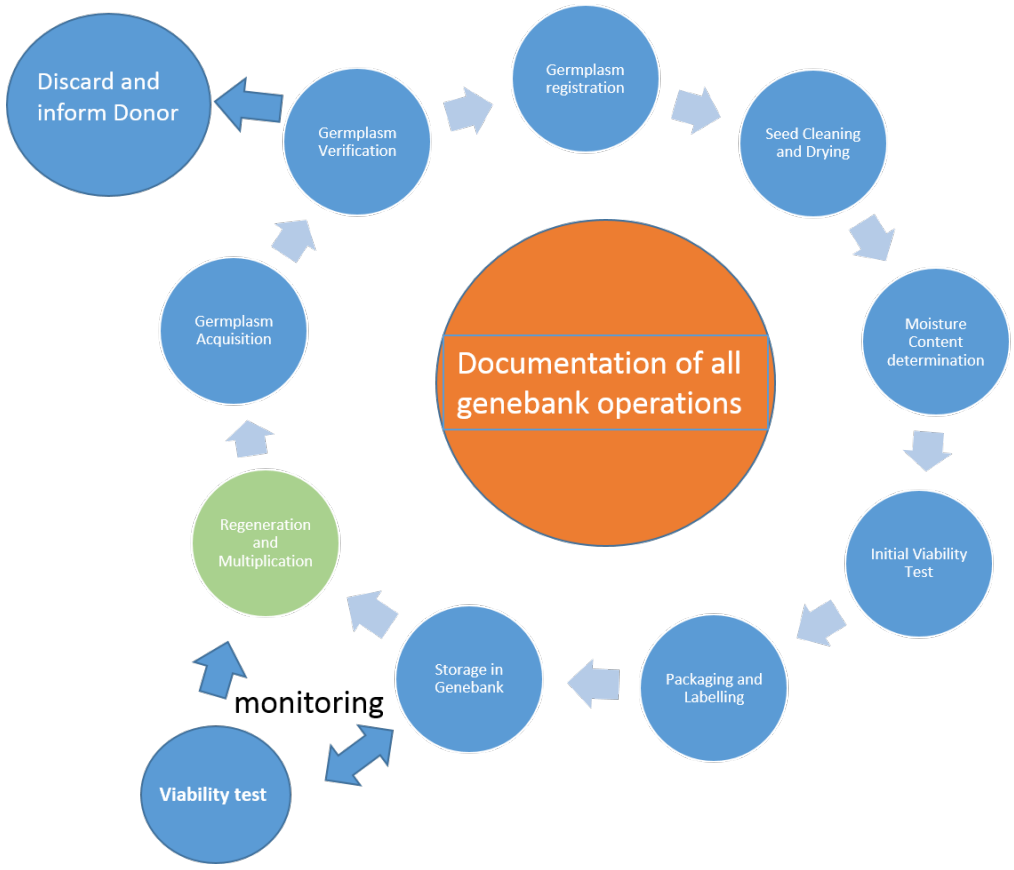
At the NPGRCs level, the situation is very different. The original basic equipment (freezers, Munthers' seed dryers, aluminium foil sealing machines, moisture content analyser and germinators) mainly provided by the Nordic programme are still functioning, butmost of the them are now getting old and need to be replaced. For example, the seed dryer in Mauritius and Botswana are both not working. In the three NPGRC,visited acquiring equipment is a major challenge, although it is reported that in some countries, it is possible to get some equipment with financial support from the government or other donors.

Current Work flow in SPGRC genebank

The current work flow at SPGRC genebank is described below and a flow diagram given in Figure2.

Germplasm acquisition: When materials are received by SPGRC from member states, the packets of seeds received are first checked against the list accompanying the seeds. The seed packets are then opened to check for their seed health quality and purity (insect-damage, fungal growth, damaged broken seeds empty or shrivel seeds) and seed quantity. If seeds are in poor conditions, the accession is discarded and donor informed.

Figure 2: Work flow in SPGRC Regional Genebank



Germplasm registration: The passport information accompanying each accession is recorded in SPGRC Documentation system (SDIS). The registration of the accession is then carried out and SPGRC gives it a new accession number prefixed by SPGRC.

If the seed quantity does not meet the seed sample quantity standard (1500 seeds per accession) and is pest and disease free, the accession is sent to the field for multiplication and the donor is, in theory, informed. It is not always the case that the donorsof the material are informed.

Seed moisture content and initial viability test: If theamount of seeds is in adequate quantities and the material is clean and free of any visible pest and diseases, the seed moisture content and the initial viability are then checked. If samples are at the accepted MC level (5-8% MC) and seed viability is greater than 85%, they are sent for packaging. If not, materials are further dried, or if materials are of low viability (<85%) or are of limited quantities, they are sent for regeneration in the field at SPGRC. The donor of the material is informed. It is not clear if there is a discussion with donor to decide where regeneration needs to be performed. Regeneration and multiplication is recognized as a responsibility of the NPGRC with the support of SPGRC in the establishment agreement. In the current workflow, it is not clear how the responsibility for regeneration is delegated or managed.

Field staff working under the *in situ* programme are responsible for multiplication or regeneration (green circle). But the *ex situ* team is responsible for the regeneration and multiplication of the accessions and provides the protocols for growing out the accessions. The multiplication or regeneration is done between the months December and April. During this period, SPGRC recruits casual labourers to help with farm operations of land preparation, weeding, fertiliser, irrigation etc. After multiplication or regeneration, the seeds are harvested, checked, registered, cleaned, and dried to the required MC for storage.

Seed drying: Drying is performed in a seed drying room which is maintained at Relative Humidity (RH) of 15% at a temperature 15C. Seeds are dried until MC isbetween 3-8% depending on species. The moisture content is determined using a moisture content analyser, a non-destructive method. When the seeds reach the correct MC, an initial seed viability test is carried out.

Seed packaging: The seeds are packaged in glass bottle for long-term conservationand 100 seeds are packed in each of 5 packets of aluminium foils for viability monitoring.

Labelling: Labels are then prepared and printed on paper stickers. Labels on bottles only includes the batch reference while on aluminium foils, batch reference, species name, harvest year and date stored are noted. In addition, the bottles are engraved with the SPGRC batch number, while for aluminium foil bags, the batch number is handwritten with permanent marker. (Note batch number is combination of SPGRC accession number and batch number following regeneration batch.)

Storage: The glass bottles and aluminium foilbags are then sent to the genebank for storage. The bottles are placed in numbered carton boxes that are stacked in a chest freezer. Chest freezers in the genebank are numerically ordered.Fivealuminium foil bags for each accession are stored in separate freezers.

Viability Monitoring: Accessions are monitored every 5 years for viability. One aluminium packet is removed from storage and viability test performed. If viability falls below 85%, the accession is sent for regeneration. This should be done in consultation with the NPGRC but it is not clear if they are informed.

Documentation: For all the stages above, the data is captured and stored in the SADC Documentation and Information System (SDIS) (orange circle).

Generally,the reviewers agree that the work flow described is in line with major guidelines for genebank management. If the procedures described above are correctly implemented in practice, then we can be sure that materials would be conserved at the highest standards and SPGRC would be meeting its objective in effectively conserving, documenting and guaranteeing the safe preservation of plant genetic resources in the region. However, the major finding of the review is that the SPGRC regional genebank is not operating at its optimum and there is much work to be done to improve its performance.

Threeoverarching concerns picked up by the review team are as follows:

1. **Lack of Standard Operating Procedures (SOPs):**It has been observed that there are no clearly written SOPs in the genebank describing the procedures of the different genebank activities. In the absence of such an SOP, it was difficult to assess whether the work flow

and proper procedures for the different genebank activities are being properly implemented and documented to the standards described.However, we do not question the competence of technical staff, who aredoing a great job, but it is important that processes are well described for others to follow in the future. It has been brought to the attention of the reviewers that on the request of the incoming head of SPGRC, SOPs for major activities of the genebanks are being prepared. This is a move in the right direction. It is urgent that these SOPs be finalised and be peer reviewed by international experts to ensure that they follow international standards and are validated.

2. **Record keeping**: The review found that there is much confusion within the SPGRC *ex situ* team around the documentation system. It was not entirely clear from the explanations received, how data are captured and stored at the regional genebank and what actual documentation system was being used. It seems that a mix of different formats (paper files, Excel, old DOS version of SDIS, and web SIDS(?)) are in use. This is a really a serious issue and SPGRC should endeavour to resolve this problem at theearliest. The proper documentation and record keeping of all the stages of the genebank is critically important for sound genebank management. (See section on Documentation.)
3. **Collaboration between programmes**: The reviewers also felt that a major hindrance which may be affecting smooth running of the work flow and the performance and efficiency of the genebank team is the current state of the collaboration between the *ex situ* program, (who is responsible for the genebank), *in situ* program, (who is responsible for the field operations), and the information management program, (who is responsible for the documentation),whichneed to work together to ensure an effective and efficient genebank management.

It is our view that SPGRC regional genebank needs to consider the development of a Quality Management System (QMS) as a priority to ensure that its genebank activities are being carried out at high standards for the long term.

Quality Management System (QMS)

A QMS would allow SPGRC to define the necessary activities to ensure that its genebank is meeting all the relevant policy and technical standards. A QMS can be applied to all genebank operations, staff capacity, staff succession, infrastructure, equipment, information technology and data management, user satisfaction, risk management and operational policies.It would further help to outline ways to constantly improve its administrative, technical and operational performance. By adopting a QMS, it would allow SPGRC's stakeholder (NPGRCs), SADC Secretariat and donors to recognise and confirm thecompetence, effectiveness and efficiency of the regional genebank and will develop the needed trust from its member states that it is capable to guarantee the safety of their PGR that have been place in trust in regional genebank.(See more details about QMS on links.[2])

Staff succession

There is no plan for staff succession in SPGRC, at the senior level. The contracts of the senior staff, (Head of SPGRC and three Senior Programme Officers (SPO)) of the centre are of a four-year duration and renewed only once, according to SADC administration rules. The previous head completed his tenure last year and a new Head of SPGRC was appointed in July last year (2017). The three SPOs will be completing their second term at the same time in May2018. The recruitment of new staff has already been initiated and it is hoped that the new senior staff will be recruited before the outgoing senior officers leave. On the other hand, technical officers are locally recruited and can be renewed as many times until their retirement age of 60 years. This means that Technical officers have a longer permanent position and play a critical role in SPGRC for the continuity of the activities and security of the genebank collections. The short tenure of Senior staff is seen as a major risk factor for SPGRC and

[2] https://www.genebanks.org/the-platform/quality-management/
https://www.wur.nl/en/Expertise-Services/Statutory-research-tasks/Centre-for-Genetic-Resources-the-Netherlands-1/CGN-Quality-Management-System-1.htm

should be addressed by SADC secretariat or greater effort made to plan for staff succession.It is also suggested that SPGRC propose new measures to SADC Secretariat for staff succession to be done in a way that would ensure continuity.This aspect needs to be considered as part of overall QMS development and Risk management exercise for the centre.

Staff Training

As mentioned above, the reviewers consider that the technical officers are the most critical staff of the genebank in view of their tenure in the centre and every effort must be made to ensure that their capacity is strengthened with the latest techniques in genebank management. It was not clear to the reviewers what kind of training the technical staff have received in the past. There is therefore a need to support the further development of new and existing staff of the genebank through additional training, refresher courses, more advanced training so as to keep the staff up to date with the latest conservation techniques. It is also very important that the technical people do not work in isolation and are connected to peers in their respective domains in other regional and international genebanks to allow them to exchange their experience and get assistance when they encounter problems.

The reviewers suggest that technical staff working in the genebank go on short term attachment to International Agricultural Research Centres (IARC) genebanks that are operating at international standards. Possible centres could include ICARDA, ILRI, ICRISAT, IITA or others that conserve a wide diversity of crops.

RECOMMENDATION 4: It is strongly recommended that SPGRC implement of a Quality Management System (QMS) in order to ensure that processes are transparent and meet international standards. The development of a risk management strategy should be a key component of the QMS. We further recommend that the QMS is audited not only internally but also by outside experts.

RECOMMENDATION5: The SPGRC QMS should be extended to all the NPGRC genebanks.

Status of infrastructures, equipment and operations

Inventory of accessions

SPGRC genebank currently holds 18,000 unique accessions (SPGRC self-assessment) compared to 10,834 unique accessions in late 2005 (Bagwe et al,2006), representing a 66% increase. At the regional level, it is estimated that the total number of unique accessionsheld by NPGRCs is 44,000 (SPGRC self-assessment report), while the user survey carried out by the Crop Trust revealed that 12 out of the 14 NPGRCs genebanks that responded to the survey hold 48,397 unique accessions as at November 2017.Besides the discrepancies in the number of accessions from different sources, the above analysis shows that only between 37-41% of the indigenous diversity conserved in the region are safely duplicated and 59-63% of the regional diversity is at risk. A key question here is why NPGRCs are not sending all their material to SPGRC for safety duplication. What are the key constraints that are preventing the safety duplication being done? It is evident that the SPGRC regional genebank does not currently have the capacity to conserve the total number of accessions from the region with the current set up (see Storagesection below). If this is the case, SPGRC should aim to increase their conservation capacity to meet their mandate (see our recommendation under storage), as a safety back up for the SADC region.

RECOMMENDATION 6: It is recommended thatSPGRC, in close collaboration with NPGRCs, carry out a study to identify the constraints that are preventing NPGRCs to safely duplicate all their accession at the regional genebank. Further a safety duplication action plan for the region should be agreedto reduce the risk of loss for national diversity conserved *ex situ*.

Germplasm registration

Germplasm registration is the assignment of a unique identification number called an accession number to a seed sample received by the genebank. This is a standard practice in all genebanks. However, in the context of SPGRC, the SADC regional genebank has a special mandate to serve as a safety back up of accessions already registered in NPGRCs in the region. In the SPGRC regional genebank, a new accession number pre-fixed by SPGRC is given to all germplasm that they receive from NPGRCs. The fact that SPGRC is giving a new accession number for materials that already have a unique accession number given by NPGRC could lead to confusion for users of germplasm on how the material is referenced. Further, the use of Digital Object Identifier (DOI)[3] as promoted by Article 17 of Global Information System (GLIS) under the International Treaty on Plant Genetic Resources for Food and Agriculture to uniquely and permanently identify PGR should also be taken in to consideration. This issue deserves further discussion with the NPGRCs in the region. The reviewers suggest that accession number provided by NPGRCs should be maintained as the primary unique identifier of the accession and that NPGRCs are encouraged to apply for DOIs from the Treaty. SPGRC should thus not assign DOI for the duplicate collection in the regional genebank. This has the advantage that materials are readily recognisable as belonging a specific country. However, for management purposes, SPGRC can continue to assign a SADC number for internal use. If this is implemented it will have some implications on SDIS.

RECOMMENDATION 7: It is recommended that the unique accession number issued by the donor NPGRC be maintained as the unique identifier for the germplasm. NPGRCs should be encouraged to apply for DOIs from the International Treaty on PGRFA.

Seed storage infrastructure

SPGRC holds a separate budget of 75,000 USD annually for acquiring new equipment. This allows SPGRC to procure new genebank equipment when required. They recently procured a new seed dryer and a germinator. With the current SADC policy on capital purchase, freezers in the genebank are replaced every 4 years. However, the freezers being used in the genebank are built to last for more than 10 years. This practice of frequently changing freezers has implications for the cost of long-term conservation. Consequently, there is a need to review the purchase of freezers as standard capital items in the genebank so that it better matches the expected lifespan for the item. Obviously, it is important to constantly monitor the functioning of freezers and ensure that they are in good working conditions and if a freezer (even if new or less than 4 years) is faulty, they should be replaced.

The regional genebank in SPGRC contains 75 freezers maintained at -20 C, and 72 of them are full, representing 96% of the storage capacity. For all intents and purposes, it is considered that the genebank is operating at full capacity considering that the three spare freezers are needed to accommodate accessions should any of the genebank freezers break down. There is clearly a storage shortage at SPGRC to expand its collection to serve as safety backup for more than 44,000 accession that needs backup from the region.

SPGRC is making plans to expand the genebank witha large number of new freezers. The review team considers the useof a battery of freezers for long term conservation is an option for collections of a certain limited size.To accommodate the PGR diversity within the region, expanding the genebank with a new set of freezers may not be cost effective in the long term. It is evident that the existing space within the SPGRC genebank can be better optimisedinitially with a change of containers from bottles to aluminium foils bags. However,this may not free up enough space for the future. Thus, a study should be carried out to comparethe long-term cost oftwo options of expanding the genebank with either a new set of freezers or setting up standalonecold rooms. The study should also consider the use of alternative energy technologies such as solar power, which could bring significant annual savings on the electricity bill in the long term.

[3] http://www.fao.org/plant-treaty/areas-of-work/global-information-system/doi/en/

RECOMMENDATION 8: The reviewers recommend a review of the policy for the routine replacement of freezers in the genebank so that it better matches the expected lifespan for the item. However, freezers should be constantly monitored and if found faulty, they should be replaced immediately irrespective of time.

RECOMMENDATION 9: It is recommended that a comparative costing study be commissioned to examine thelong-term cost efficiency of usingstand-alone coldrooms as opposed to the battery of freezers for long-term storage.

Genebank security

It is very important that security of the genebank is monitored and any risk of malfunction averted. SPGRC has the important responsibility in securing the diversity of plant genetic resources of the SADC region over the long termon behalf of its member countries in SADC region. In view of this, the security of the collection being managed by SPGRC is of utmost importance. Currently there are no real time security systems to alert whether the freezers are working or not. A general worker does a daily round to check freezers, but no records is made to register the status. There are no fire extinguishers within the genebank itself, although they are found along corridors of the building. The central air circulation tunnel is not working and a series of air conditioners have been installed. The security of access to the genebank also needs to be improved. Some security issues were highlighted by Mr Obreza (see section on Documentation below), which seem not to have been addressed.

RECOMMENDATION 10: The reviewers strongly recommend that SPGRC take all appropriate measures to significantly improve the security of the base collection. As recommended by Mr Obreza, the reviewersconcur that a temperature sensor within each freezer be installedtorecord the temperature data using an online system. Other security measures such as installing a fire alarm in the genebank, repairing the air circulation tunnel, and improving the access control to the genebank are required urgently. These should be part of the risk management assessment and plan (see recommendation 4)

Storage containers

Currently, accessions for long-term storage are stored in bottle containers and 5 aluminium foil bags for viability monitoring that are normally kept in a different freezer. It was observed that many of the bottles in storage freezers were not completely full, a wastage of space in the freezers. The review team considers that while the conserving in bottles containers worked well at the SPGRC when it was a small genebank, it is now evident from the review, that this is no longer the case. The bottle containers are occupying too much space, making the conservation system very inefficient.

Currently paper labels are used on containers both bottles and aluminium foil bags. On the bottle, only SPGRC accession and batch numbers are written. However, on aluminium foil bags, batch reference, species, harvest year and date stored are recorded. The batch ref is also engraved on the bottles. It has been observed the recently used labels are of poor quality and can easily be peeled off. In the near term, SPGRC should adopt a bar coding system (as part of the QMS system) to label all packs in a similar manner, to avoid errors and to capture more of the accession level information on the pack. There is also a need to review the quality of the labels used in the freezers.

RECOMMENDATION 11: It is recommended that SPGRC reviews its storage and packaging procedures to improve its storage space and its sustainability, paying particular attention to the following:

a) **All accessions be stored in aluminium bags in the future. For any new accessions to be banked, only aluminium foil bags should be used. For all the current accessions stored in bottles, SPGRC should develop a plan with annual targets to progressively transfer all accessions to aluminium foil bags. From a**

review of the store, it seems they have enough bags to start this transfer process.

b) **In the short term, higher quality, longer lasting labels should be used**
c) **In the medium term,SPGRC should adopt a system of bar coding for all the accessions in the genebank to increase the security and cost-effectiveness for all processes in the genebank.**

Seed viability testing

Previously SPGRC was outsourcing the seed viability testing to the Seed and Certification Institute at Mt. Makulu in Lusaka, Zambia (Bagwe et al, 2006). However, this practice has stopped because that institute is no longer able to offer this service to the genebank, as there is an increasing number of private seed companies in Zambia requiring seed certification. A technical officer of the *ex situ*conservation programme assisted by a general worker do the viability testing. The viability tests of accessions in base collection are undertaken every five years. Data is entered in a germination record sheet and put on file. Although it is reported that results of viability tests are communicated to the donor of the accession, there is no evidence to show that this is the case. Some NPGRCs have been critical in that such information is not available to them. Monitoring of viability of the collection is an important activity in the genebank to ensure that the accessions are not lost. Monitoring plans and the results of the viability tests should be coordinated and shared with the NPGRCs. If the seed sample held by the SPGRC is losing viability, there is a high probability that the same seedlot in the NPGRC is also losing viability. Thus, SPGRC should work with the NPGRC to address the regeneration needs for both samples. This could be done at the NPGRC or SPGRC but insuring that the two samples do not diverge significantly during the regeneration process.

RECOMMENDATION 12: It is recommended that SPGRC should develop joint monitoring plans and coordinate the implementation of viability tests and regeneration of accessions with NPGRCs. Results should be exchanged between both parties and used as the basis for coordinate plans for accession regeneration.

Multiplication and regeneration

Although it is stated that multiplication and regeneration of materials remains the responsibility of NPGRCs, in practice, SPGRC grow out on average 400 accessions per year (Qhobela, pers com), mainlyfor multiplication. The major reason given for the grow-out is low quantity of seeds per accessionnewly received from NPGRCs.Table 1 below shows the number of seed multiplications carried out at SPGRC during the last 5 years.

Table 1: Seed Multiplication over last 5 years

Year	Number of accessions multiplied
2013/2014	300
2014/2015	300
2015/2016	265
2016/2017	383
2017/2018	500
TOTAL over 5 years	1748

When we compare the number of accessions in need of multiplication with the number of accessions received by SPGRC from member countries (Tables 1 and 2 respectively), we note that the great majority (95.41%) of the amount received will need to be multiplied. There is clearly a major problem with the quantities of seed that are being sent by NPGRCs to SPGRC. The key here is that adequate quantities of seeds should be collected at the time of collecting for conservation in NPGRC genebank and for safety duplication at SPGRC (as well as to Svalbard) to avoid need for multiplication. There should also be discussions with NPGRCs to see if they can send over new materials through new collection rather than having to multiply materials received. It seems from the review that the decision to multiply is taken unilaterally by SPGRC and there is little discussion with NPGRCs.

Table 2: Number of accessions received from SADC member countries in last 5 years (2013 to 2017)

Year	Country of origin	Number of accessions received	Total
2013	Botswana	279	364
	Malawi	9	
	Mauritius	41	
	Angola	35	
	Namibia	32	
2014	Malawi	56	688
	Mauritius	27	
	Angola	40	
	Namibia	20	
	Tanzania	545	
2015	Namibia	24	193
	Mozambique	78	
	Malawi	29	
	South Africa	62	
2016	NONE		
2017	Malawi	84	587
	Mauritius	31	
	Zambia	430	
	Zimbabwe	42	
			1832

NPGRCs have consistently indicated that they consider that multiplication and regenerationneed to be done in their country of origin in proper agro-climatic areas where the accessions originate. However there have been cases, where an NPGRC has requested SPGRC to carry out multiplication/regeneration for them, for example the case of Malawi and Namibia (see conservers survey Annex 1). It is doubtful how much multiplication/ regeneration at national level is being done because of costs and availability of irrigated land and technical capacity for regeneration of particular accessions that are difficult to regenerate. Some countries such as Zambia arefacing difficulties in multiplication and regeneration because of the lack of irrigated lands to carry out these activities. In other countries, such as in Mauritius, the capacity to multiply/regenerate some accessions is proving to be a problem. It is evident that there is need for more capacity building of local NPGRC staff for properly carrying out multiplication/regeneration for conservation purposes. Specific regeneration protocol for crops for which these do not yet exist need to be carefully prepared by SPGRC and the NPGRCs. Special attention needs to be given to the isolation distances between accessions.

It was noted earlier that SPGRC has expanded their irrigation system from 4 ha in 2006 to 12 ha currently, out of a total 22 ha. However, it appears from discussion with SPGRC staff and the field visits that the second expansion is not working optimally. This should be attended as soon as possible to ensure that multiplication and regeneration is undertaking under optimum condition in all the fields that are to be used.

NPGRCs should not send materials that do not meet the seed sample acquisition standard. Such accessions should rather be multiplied in the country of origin, unless, as mentioned above, there are good reasons for the multiplication be done at SPGRC. SPGRC should also be notifying the depositors of germplasm if the material has viability below regeneration standards and ask them to regenerate the whole accession in country of origin and send fresh materials for safety duplication. Multiplication and regeneration is the most costly operation of

the genebank as well as the event where there is a high risk of genetic erosion. It would be minimised as much as possible and for this reason, proper planning from the time of collection; how materials are shared for safety duplication;and capacity at NPGRCs for multiplication should be facilitated by SPGRC. It was felt that the role of SPGRC, especially in regeneration activities,should be to facilitate and help source funding to carry out regeneration and to organise regeneration activities within specialised institutions in the region.

RECOMMENDATION 13: To address the bottlenecks for multiplication and regenerations, it is recommended thatSPGRC should:

- **Promote and facilitate the development of a regional regeneration plan, which would define the regeneration needs of NPGRCs,how regeneration couldbe done, and agree on who needs regeneration support;**
- **Provide capacity building for NPGRC who needs technical support for regeneration of specific crops**
- **Engage in a more active partnership with NPGRCs,CGIAR research sites in the region (such as ICRISAT or IITA), Universities, or the private sector, who have expertise and facilities to carry out regeneration collaboratively or on their behalf.**

Characterisation and Evaluation

Characterisation and evaluation are two distinct activities.Characterisation refers to the description of highly heritable characters that can be easily seen by eye and are expressed in all environments. Evaluation is the testing of accessions in different environments and is an expression of given character or descriptor in relation to its environment. We consider characterisation as being a routine genebank operation, but not evaluation. So, in this review we would only consider the characterisation activities.

Characterisation: It is not clear how much characterisation is being carried out by NPGRCs. The self-assessment by SPGRC remarks"*There is need to fully characterise all the collections in the Member states and at the SPGRC so that they can be fully utilizable in crop improvement programs of the region and beyond.*"

In our survey more than nine countries reported to have characterisation data on their accessions (although we do not know how many accessions within their collection have characterisation data), but very few countries have providedcharacterisation data to SPGRC genebank. Bagwe et al (2006) also found the information on characterisation data from NPGRCs and SPGRC genebank as not being consistent. They suggested that a technical audit for characterisation is required to compare data in SPGRC with those in NPGRCs. Perhaps one of the key obstacles in sharing characterisation data is the issue of data ownership and sharing. Member countries may be reluctant in sharing characterisation data in fear that third parties may freely use this information without proper acknowledgement of the source. It is a fact that all data provided to SPGRC belongs to member countries of SADC region and as such countries have ownership of these data. Characterisation however adds value to genebank accessions and such data should be made availableso that materials can be utilised by bona fide stakeholders to contribute to the ultimate goal of ensuring food security. It is important therefore that proper mechanisms be put in place toensure that the ownership of the associated data of materials held in SPGRC isacknowledged while being made available and accessible to bona fide users following strict terms and conditions of usage. This can be realised by using a Data Sharing Agreement between each NPGRC and SPGRC.

RECOMMENDATION 14. It is recommended that a Data Sharing agreement between NPGRCs and SPGRC should be developed to facilitate and promote the sharing of characterisation (and other relevant) data.

RECOMMENDATION 15: The reviewers recommend that an in-depth audit of the number of accessions with characterisation data in the region be carried out, as a first step to prioritize and rationalize future work in this area.

Documentation

The review team took note of the reports of Bagwe et al (2006) and thatof Matija Obreza, Information System Manager at the Crop Trust, who visited SPGRC in March 2015 to discuss genebank documentation practices and information system and to identify any constraints to effective data management.

Bagwe et al (2006) describes the SADC Documentation and information System (SDIS) as follows: "*The structure of the SDIS follows that of the SPGRC as a core unit within a system of autonomous NPGRCs. Hence SDIS is not a centralised system accessible on a website, but a 'federation' of users of a common system. The entry of data on accessions in active collections is the responsibility of each country. All other countries have access to these data but may only edit their own. Data are transferred to SPGRC is currently done manually using diskettes and CDs (but will be done by ftp once a decentralised, web-based version is available), and the SPGRC is responsible for distributing updated versions to all countries*[4]*. The unique responsibilities of SPGRC are to keep the base collection updated in SDIS and develop the SDIS system.*"

Since then, the system has been further developed into a web-based version. This should allow a 'real-time' accessibility and updating of the database.The report of Mr Obreza also described the evolution of the SDIS. Essentially the SDIS was originally developed in MS-DOS and then was migrated to Windows version in 2000 and since 2007,a web-basedversion has been developed by a private company in Lusaka. SDIS can be regarded as a regional genebank management system, providing a platform for regional collaboration and for allowing exchange of information among the partners and other stakeholders. It should also be recognised that SDIS provides a backup of data for NPGRCs collections which can be used for repatriation back to national programme should they lose data at their end. A case in point is the example of Zambia that lost all its data on its computers and server as a result of a theft in the genebank. The Zambian genebank was able to retrieve its data from SDIS and re-establish its data base.

Good record keeping is critical for the effective and efficient management of a genebank, as well as for effective conservation and making germplasm available and accessible to prospective users. In SADC region context, having a common harmonised documentation system for the NPGRCs is fundamental to effective functioning of SPGRC as a regional genebank network. In the SADC region, documentation of genebank operations has evolved from manual registrations to computerised systems, including a web based SDIS. Our observations are that the documentation of the different genebank operations at SPGRC and also at the NPGRCs visited are still in a mix of different formats, using paper files, Excel, old DOS version of SDIS, web SDIS (different versions). There areseveral parallel systems operating in the region at the moment which need to be harmonised so that data can be easily compiled and shared among the stakeholders. The development of the web-based version of SDIS is a good move in that direction, but it is yet to be finalised and rolled out in the region. NPGRCs need to be supported by SPGRC to ensure that they have the necessary information tools to document their genebank data in a harmonised way across the region.

Mr Obreza made 10 recommendations that could improve the documentation of the base collection and at NPGRC collections, including recommendation on the SDIS information system. In this review, SPGRC was requested to provide feedback on the Mr Obreza's recommendations (see their responses in Annex 5). SPGRC seems to have taken all the recommendations seriously and is doing its best to implement these recommendations.

[4] Except the originator, since an error may over-write their data.

However quite a few of these recommendations are yet to be achieved and are still valid to-date.

RECOMMENDATION 16: **We concur with recommendations of Obreza (2015)toSPGRC to ensure that NPGRCs are supported in providing a common harmonised documentation and information system.**

Web-SDIS

Development and deployment of web SDIS: During the review, the Senior Programme Office (Documentation) and the IT technical officer made a presentation on the web based SDIS version. The review team was very impressed with the simplicity and functionality of the system. The web-SDIS is based on a local host. The SDIS holds the regional database, which is accessible to the public http://www.spgrc.org.zm/regional-data-base via the SPGRC website. Browsers can search for accessions for each country. However, in checking the information on the number of accessions from different countries from the regional database, we note that the numbers obtained does not match the number of accessions at the NPGRCs and/or those sent to SPGRC.Total of 1494 entries are listed on web SDIS from only 8 countries (Angola, Botswana, Lesotho, Malawi, Namibia, Swaziland, Tanzania and Zambia). This means that not all NPGRCs are using the web SIS to document the accession on web-SDIS and that there are issues in the use of web SDIS.

Each member country (NPGRC) has been provided with username and password to enable each NPGRC to enter their own data and manage their information on SDIS. Each member country can also view the data from other NPGRCs but cannot make any changes to the data from other NPGRCs**.**

It is noted that some of the technical recommendations made by Obreza in the development of SDIS, has been implemented to some extent, as for example recommendations on use of Multi-Crop Passport Descriptors (MCPD), software ownership, following work flows in genebank, interaction with developers have been implemented (see Annex 5).

A working version of the web-SDIS is now available and is now ready to be tested.Individual trainings on web-SDIS for an average of 2-3 days has been provided to most SADC Member State genebanks (Angola, Botswana, DRC, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, Swaziland, Tanzania, Zambia, and Zimbabwe), with the last one being conducted in South Africa in mid-January 2018. Training for the newly admitted Comoros is planned for the future. Despite these training sessions it is not evident to the reviewers that web SDIS is fully implementable in many of the countries in the region and if there have been sufficient consultations with NPGRCs and with SPGRC *Ex situ*Conservation programme in its design and development. We think this is an important aspect that SPGRC should take into account in its further development so that it meets with the expectations and needs of the NPGRCs and that it takes into account the work flow in the genebank. In discussion with some NPGRCs, it was noted that not all countries could effectively use web SDIS either because of connectivity problems (e.g. in Zambia NPGRC) or lack of capacity (e.g. in Mauritius). In Botswana NPGRC, they find the new SDIS easy to use, but have some disadvantages, as not all the information that was in the old version isavailable in the web version. Specific references to the absence of characterisation data for all crops were made.

At the SPGRC regional genebank the web SDIS was still not deployed and used by the genebank team. If SPGRC should lead-by-example for information systems, as recommended by Obreza, it is evident that the SDIS systems should have beendeployed first in SPGRC genebank in close collaboration with its *ex situ* team so that it can be the first genebank to test and adopt the system. This was not very evident to the reviewers. The Technical Officer (*Ex-Situ*) at SPGRC explained that the DOS version of SDIS on the genebank computer is being used for the printing of labels. At the time of the review, the *ex situ* team were not using the Web version and were keeping records on paper files that are transferred to Excel. They reported that they used the old version of SDIS in the past for transferring data from paper records but stopped with the development of the web version. The documentation situation at

SPGRC is rather confusing. However,SPGRC hasreported since the review team visit that the Technical Officer (*Ex-Situ*) at SPGRC has been trained and migration to new web-SDIS has started. Some reorganization has also occurredwhereby the Documentation and Information officers are spending more time working ongenebank data management needs.

Functionalities of web-SDIS: Based on the presentation of the web SDIS, reviewers made a few suggestions for the improvement of documentation and information systems.

The home page of SDIS provides a dashboard and provides some general information on the regional collection. It was felt that while some of the terms are intuitive, others may not be clear enough. There should be some explanation of the terminology used on the dashboard. It is suggested that a user manual, online training programme and a helpdesk would help users better understand what SDIS offers and how to use it. Further it is also felt that the SDIS could provide additional information on genebank management to the genebank curators. There are many good sources of information accessible from www.genebank.org as well as from Bioversity international website www.bioversityinternational.org.

In the registration menu, many of the passport data fields are pre-set and have a pull down menu.The list of scientific nameswas generated by SPGRC staff based on The Plant List by Mabberley, in which many of the scientific names are already outdated. It is recognised that changes to plant names are being made all the time by taxonomists and it would be hard to keep the system up to date. It is suggested that the system uses the GRIN-Global taxonomy database as its standard reference for scientific names and tools exist for the validation of passport data, for examplehttps://validator.genesys-pgr.org/.

The review team also suggested that an automatic upload system from excel sheets into SDIS is produced. At the moment all data are manually inputted in the web SDIS and this can be a major source of errors, leading to inaccurate information about the accessions. The Crop Trust could help to find someone to program this. Under Collection, it was also suggested that users should be able to upload additional files containing information about the accession. For example,Excel sheets with molecular data or evaluation trial results.

It was observed that web SDIS did not show the data on initial viability test. This information is important, as it is an indication of the quality of the seeds when they were first collected, processed and stored. It also gives an indication on which accessions need to be more closely monitored. For example, if an accession has 99% initial viability and another has 85.1% initial viability and the latter mayneed to be prioritised for monitoring as it is at the limit of the regeneration threshold.

Web SDIS generates a unique accession number for each new seed sample that enter the genebank. The accession number is only generated when all the passport data fields are inserted into the system. While this is good and provides useful information, in practice most of the passport data made mandatory by the system may not be provided, with the consequence that no accession number will be created. This will limit the number of materials that can be registered. For the SPGRC regional genebank, the issue of germplasm registered is discussed in an earlier section.

Conclusion on Documentation system

It is our opinion, that SPGRC should seriously review the future of SDIS and if it really meets the needs of the NPGRC. We are not convinced that the system has been developedclosely enough within the network of NGRCs and the *ex situ* programme of SPGRC itself. This review should be discussed in the Annual Technical Meeting with members' countries. The network might consider alternative ready-mademodels such as GRIN Global. Grin Global was developed by USDA to provide an information genebank management system for its genebank network within the US, similar to genebank network of SADC region. Thus, GRIN Global has been validated internationally and is now used by various genebank in the world including CG centres. The system is supported and promoted by the International Treaty on PGRFA.

RECOMMENDATION 17: It is recommended that SPGRC review the costs, benefits and adoption rate of SDIS in the context of existing readily available options for genebank data management. If a decision is made to continue with the development and deployment of SDIS, the reviewers recommend that:

- **Documentation and Information Unit should work closely with SPGRC *ex situ*conservation programme for the effective deployment of web SDIS to the *Ex Situ* program and the NPGRCs and demonstrate SPGRC's capacity to "lead by example".**
- **As a way forward for deployment, the web based SDIS should first be piloted by 2 to 3 selected genebanks (including SPGRC regional genebank) and that it is then gradually rolled out to other genebanks, accompanied by proper in depth technical support to the countries, to ensure that they are able to use the system. SPGRC Documentation and Information unit should serve as helpdesk and provide support to NPGRC in the use of SDIS.**
- **A user manual, on-line training programme and helpdesk be developed for users to get better understanding of the web-SDIS.**
- **Further, under the resource section of web SDIS appropriate links to existing knowledge sharing systems about genebank management be established so that curators can get ready access to the literature, best practices, manuals, handbooks etc.**
- **The list of scientific names follows the GRIN Taxonomy to obtain real time up to date taxonomic reference to the taxa.**
- **An automated upload system into SDIS is provided to facilitate the inputs of data and other document types into web SDIS.**
- **SPGRC organises the migration of existing data from old SDIS into the web SDIS. This could be done either by the developers of SDIS or SPGRC documentation staff.**
- **In the storage data in web SDIS, information about the initial viability test be also provided.**
- **SDIS only require a minimum mandatory list of passport data for germplasm registration.**

Biotechnology Laboratory

Abiotech laboratory at SPGRC,with a dual function for in vitro storage and genetic characterisation, has been proposedsince the early 2000s and has been extensively debated and evaluated by several reviews (Virgin 2005, Bagwe et al, 2009). The conclusion of these reviews has been positive for the development of a modest lab that would carry out in vitro storage, molecular characterisation and basic biotech work (Bagwe et al, 2009). Plans for its construction have been developed and SPGRC is now seeking the funds for its construction.

In the reviewers'opinion, SPGRC should review its priorities in deciding whether the investment in a new biotech lab will help enable it to achieve its objectives and if this option would be cost effective. There are three issues thatSPGRC needs to consider:

Need for an in vitro storagefacility – the aim here is for SPGRC to embark in the conservation of vegetatively propagated materials. There are many important crops in the region that are vegetatively propagated or have recalcitrant seeds. The reviewers understand that collections have been made of some of these crops, such as cassava and sweetpotatoes, by NPGRCs but they have been lost due to disease, the lack of irrigation, and the lack of secure field sites. Thus, there is a need for SPGRC to consider how to address the conservation needs ofthese crops regionally and nationally. In vitro conservation is a technique which requires specialised skilled staff and is technically very demanding and cost of operation is much more expensive compared to other conservation options. As SPGRC considers options to secure these crops in *ex situ* collections in the region, it should explore alternative models for conserving vegetatively propagated plants in the region, such as initially

establishing a secure field genebank that can be used by the NPGRCs. It has adequate field space on its farm to be able to establish secure field collections for the NPGRCs. In addition, SPGRC could facilitate the use of in vitro conservation with the establishment of a partnership with more specialised institutions that are already set up for in vitro conservation such as IITA, which has a very good in vitro facility in Lusaka and Dar es Salaam, or CIP in Mozambique. Another option to consider in the longer term is the development of cryopreservation for the conservation of vegetatively propagated and species having recalcitrant seeds.

Molecular characterisation - Nowadays there are many laboratories worldwide and in Africa to which genotyping can be easily outsourced at very reasonable cost. SPGRC should consider this option rather trying to set up its own facilities.

Bioinformatics capacity- Further SPGRC would need to develop capacity in the analysis of genomic data. Molecular characterisation would generate a lot of data and this will require the development of the bioinformatics capacity in SPGRC to be able to store, analyse and interpret genomics data. This is essential to make the whole initiative worthwhile. Thus, for the future, SPGRC should explore the option to invest or establish a partnership to accessregional bioinformaticscapacity while outsourcing the genotyping work to specialised institutions.

RECOMMENDATION18: It is recommended that SPGRC should further discuss its priorities in establishing a biotech laboratory and consideralternatives and partnerships for conservation of vegetatively propagated crops and genomics work.

Communication and visibility plan

Visibility of the role and functions of SPGRC to the external world is fundamental for its long-term sustainability. The communication and awareness raising for SPGRC activities is devolved to the Documentation and Information Programme. Whenever the opportunity arises, the programme organises and/or participates in public events. Key awareness activities include the production of fliers, brochures and posters for exhibitions,and agricultural shows, interviews etc.In Tanzania for example, the SPO Documentation was interviewed on the local television about the work of SPGRC. The website of SPGRC is also a medium for making publicity about the SPGRC activities.It also uses social media to promote its activities. SPGRC produces a newsletter every 2 years but finds it hard to get many inputsfrom NPGRC. The programme receives between 30-40,000 USD annually for its public awareness activities. The staff of the Documentation and Information Programme is only able to devote 8-10% of their time to communication activities. Further at the SADC FANR level there is a Public Relations Officer responsible for communication and visibility of all activities within SADC. It is important that SPGRC also targets this office in its own communication and visibility raising and uses the resources there for raising awareness of its activities. It is felt that actions on communication and public activities are done too much on an ad hoc basis. It is important that SPGRC give this activity priority to raise further its visibility. What is needed is for SPGRC to develop a clear Communication and Visibility Strategy, including a resource plan to guide their public awareness activities. It is very important for the external world, in particular for the policy makers at the member countries of the SADC and prospective donors, to be informed of the work and impact of SPGRC.

RECOMMENDATION 19: It is recommended that SPGRC prepare a Communication and Visibility Strategy and an Action Plan with a budget requirement to enable the centre to raise its visibility to the external world. As an immediate step, SPGRC should work closely with the public relations officer of FANR in SADC Secretariat and regularly send inputs to the Secretariat to report on their activities at the SADC level.

Annex1: Conservers survey

Twelve of the fifteen countries requested responded to the survey. Despite the short time available for the survey, this represents an 80% response rate and is excellent. The countries that responded included Angola, Botswana, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Tanzania and Zambia.

Genebank status and collection (Q1,2,3&4): All of the respondents hold the National Genebank of the country and five of them were also part of national research institution or university (Angola, Botswana, Lesotho, Mozambique and Zambia). They all held a collection and the total number of accessions reported by the 12 national genebanks in the survey amounts to 48,397 accessions, with a range varying between 538 (Mauritius) to 7000 (Madagascar). In terms of the percentage of their accessions that have been duplicated at SPGRC, the countries reported about 34% on average (excluding Madagascar). Madagascar has to date not duplicated any of their materials to SPGRC. This represents about 15,239 accessions that are duplicated at SPGRC. (see table 3).

Table 3: Number of accessions reported by Countries and % safely duplicated at SPGRC

COUNTRY	No accessions	% safely duplicated at SPGRC
Angola	4200	32%
Botswana	4126	56%
Lesotho	1519	30%
Madagascar	7000	0
Malawi	4613	45%
Mauritius	538	49%
Mozambique	3307	50%
Namibia	4249	40%
South Africa	5823	12.10%
Swaziland	712	67.80%
Tanzania	6700	40%
Zambia	5600	57.10%
Total	48387	

Source of materials (Q5): The source of genetic resources held in countries' genebank are mostly their own collections, but in some cases (in Botswana, Malawi, South Africa and Zambia) the collection also includes materials from other national and international genebanks. Further Malawi also acquired materials of maize, wild rice and hyacinth beans from national breeding programmes and some accessions of barley and wheat from FAO and university research programmes.

Kind of Data available and shared (Q6&7): Most of the NPGRC (>= 9) have information on passport, characterization, seed viability, number of seeds in sample to be stored and date of harvest and number of regeneration of their collection. Quite a large number (8 countries) also have information on Indigenous knowledge. Evaluation and genotypic information as well information on seed health and regeneration requirements are poor. Only 2-4 countries have reported that they have information on these types of data.

All the countries (except Madagascar) provide passport information to SPGRC. Most of them also provide seed viability and date of harvest and number of regenerations. The rest of the accession level information is only provided by a few countries.

New seed requests of SPGRC (Q8): Most countries, except Malawi, South Africa and Zambia, have sent new seed materials for accession already stored in their facility.

Return of loss accessions (Q9): Only 3 countries (Botswana, Malawi and Swaziland) have requested SPGRC to send back materials that they have lost from their genebank. Botswana lost accessions while regenerating their materials. Malawi could not retrace some of their accession that have been back up in SPGRC. Swaziland has lost materials due non-viability and lack of germination of some materials.

Request to SPGRC to regenerate any accession (Q10 &11): In general, countries have very rarely asked for SPGRC to regenerate their accessions. But on a number of occasions Malawi NPGRC has been asked to assist with regeneration of materials from SPGRC. They are currently doing regeneration for about 350 accessions for Rice and a few years back did some regeneration/multiplication for watermelon accessions on behalf of Namibian NPGRC. Namibia has also asked SPGRC to help the genebank multiply over 400 accessions because there were not enough samples to keep in the national genebank and share with SPGRC. Madagascar would also want SPGRC to regenerate their materials, because they do not have sufficient funds to do it.

Two countries Botswana and Swaziland have requested the repatriation of their materials and acknowledged that they have received the seeds in a reasonable time and in good quality.

Report of lost accessions (Q12): Several countries also reported that examples of accessions that would have been lost if they did not have it as a backup in SPGRC. Botswana and Swaziland reported on a case of cowpea, and sorghum respectively. Lesotho reported several accessions of maize, bean and sorghum that have been damaged with weevil in their genebank. Zambia is undertaking a full inventory of their collection and seeking to identify any accessions that they have lost but still available in SPGRC base collection.

Distribution of seeds from SPGRC Genebank (Q13): All countries made it very clear that it is not the mandate of SPGRC to be distributing any of the accessions that are the ownership of the member states of SADC. They would rather distribute themselves. However, it is possible for SPGRC to distribute materials but only with the consent of the donor country.

Annex 2:Userssurvey

A questionnaire was also prepared to send to individuals that requested germplasm from SPGRC genebank. SPGRC provided a list of email addresses of those people/institution who had requested for genetic resources materials during the last 10 years. An email containing the users survey form was then sent to the addresses received from SPGRC. 16 requests for germplasm were received from 9 countries (Botswana, Benin, Lesotho, Mexico, Philippines, Swaziland, Tanzania, Uganda, and Zimbabwe) from universities, research organisations, national tree seed centre and CG centre.

Type of institution (Q1 and 2): Only 4 institutions replied to the survey. Three of the respondents were from a university and one from a crop-breeding institute. The respondents were:

- University of Zimbabwe
- University of Swaziland
- Crop breeding institute in Zimbabwe
- University of Botswana

Use of genetic material: All the respondents used genetic material for breeding and research purposes, except University of Botswana that uses it for research only

Source of Crop genetic resources: All the respondents indicated that they have their own collection and that they source material from national and international genebanks. Except University of Botswana, the other respondents also obtained materials directly from farmers. University of Swaziland also obtain materials from private growers.

Specific Traits: Except for University of Botswana, which is only interested in taxonomic work, all the other three respondents are seeking traits for resistance to pests and diseases, high yield, quality and drought resistance. In addition, University of Zimbabwe mentioned that here are other traits depending on their research goals. The Crop Breeding Institute in Zimbabwe is also interested in early maturing traits.

Type of materials frequently used: All the respondents are interested with local farmers' varieties (landraces). Except University of Botswana, the other respondents frequently use breeding lines. Wild relatives are also used in University of Swaziland and University of Botswana.

Importance of SPGRC (Q7&8): All the respondent value SPGRC as a source germplasm for their breeding and research activities. Their experience in accessing germplasm from SPGRC has also been good, although Crop Breeding Institute mentioned that information on the origin of germplasm was missing.

Constraints in accessing germplasm (Q9 &10): All respondents unanimously declared that they have not experienced any constraints in terms of policies, phytosanitary regulations, quality of materials receipts, and appropriateness of materials that were sent to them. Consequently, they are all very satisfied with the acquisition of materials from SPGRC.

Success stories and publication (Q11, 12 and 14): Only the University of Swaziland reported that they have identified useful materials (maize) for drought tolerance for further use their breeding programme and that they have publications related to breeding and research work that they are willing to share

Distribution of germplasm from SPGRC (Q13): None of the respondent distributes materials that they have obtained from SPGRC to any third parties.

ANNEX 3: Report on the site visits to NPGRCS in Zambia, Botswana and Mauritius

Zambia NPGRC:

The review team, Ehsan Dulloo and Paula Bramel, visited Zambian NPGRC in Mount Makulu on 21st November 2017. Graybill Munkombwe, who is now the curator of the Zambian National Genebank, received the team. Mr Munkombwe gave a brief overview of the Zambian genebank. The genebank was established in 1991 following efforts by IPGRI to promote the development of National programmes for conservation and use of plant genetic resources. The genebank collection is very much valued for providing materials for crop development. The Zambia Agriculture Research Institute that houses the genebank, strongly supports the activities of the genebank. Part of the collection is duplicated at the SPGRC regional genebank. The genebank has received much support from the SADC-Nordic countries programme. Staff have been trained in both Master programmes and short term training courses in Sweden.

Mr Munkombwe acknowledged the instrumental role that SPGRC has played in the coordination of conservation activities of PGRFA in the region. He said that the annual technical planning meeting is crucial for the network to function. It allows curators of the NPGRC to get together and discuss their work plan and share their experiences and develop collaborative projects. Mr Munkombwe also commented on the establishment of a Biotech lab at SPGRC that is supported by member countries. He thinks that it is a good idea that SPGRC should develop such a lab to provide a service for in vitro conservation and for molecular characterisation.

Genebank facility: The genebank is in fairly good condition. It has benefited from Nordic programme in acquiring the basic infrastructure and genebank equipment, most of which are still in good working conditions. The genebank is facing difficulties in the procurement of new equipment. The Government provides the salaries of staff, but there is no funding for operation costs. It depends on project funding to be able to acquire equipment (for example World Bank Project MAPP provided the genebank with 10 new upright freezers). The genebank is also a partner in CARDESA funded project on food legumes also involving Mozambique, Malawi and Angola. Through this project they are able to do the characterisation and multiplication of a number of accessions of cowpea, pigeon pea and Bambara groundnuts, which needs to be safely duplicated at SPGRC. Another priority need of the genebank is acquiring good facilities to carry out viability tests. Previously viability tests were done by Zambia Seed control and certification laboratory at no costs. However there has now been a growing number seed companies established in Zambia and the Seed lab is now unable continue to offer this service to the genebank.

The Zambian genebank is currently doing an inventory of all accessions to figure out what gaps exist between their collection and those duplicated at SPGRC. The genebank also held a field collection of Cassava and sweet potatoes in the past but it has been lost due unavailability of irrigation system to sustain the collection.

Seed Multiplication: The lack of irrigation system is severely limiting the capacity of the genebank to carry out seed multiplication and regeneration. The review team suggested that the genebank should explore with SPGRC the possibility of using their land for carrying out their multiplication, since SPGRC has adequate land under irrigation that might be used.

Documentation: Regarding SADC documentation and information system (SDIS), Zambian NPPGRC is still using the standalone version. They do not have any internet connection currently in the genebank and this is a major constraint for them. Security at the genebank has been a major issue recently (March 2017). All the genebank computers including the backup servers have been stolen. These were all kept in the same room at the genebank. Fortunately, the genebank kept back up of their genebank information in paper form. SPGRC has helped them to provide new computers. Also, the computer obtained through the SADC CWR project is now used at the genebank.

Links to farmers: The genebank has good links with users of germplasm both with institute breeders and farmers. However, they work more with farmers than breeders. Farmers are interested in restoring the diversity on their farms and the genebank is engaged in several activities with farmer's restoring diversity of sorghum, maize and cowpea and undertaking on farm characterisation and evaluation.

Challenges: In summary the major constraints of the Zambian genebank are:

- Facilities for germination test
- Irrigation facilities for undertaking regeneration and multiplication.
- Transport for collecting trips
- Internet connectivity is major challenge at the Genebank.
- Capacity building of staff. Staff have undergone several training courses over the years, but still require training as there is a high turnover of staff in the genebank

Botswana NPGRC

Meeting with the Director of Department of Agricultural Research, Botswana: One of the reviewers, Ehsan Dulloo visited the NPGRC in Gaborone, Botswana in company of the Head of SPGRC and had a meeting with the Director of Agricultural Research, Dr Pharaoh Mosupi and other officials of the department. The Director indicated that the relationship with SPGRC is very cordial but believes that more can be done. He emphasized that the curators of the region need to have a forum to meet and to discuss their expectations and challenges with SPGRC and other NPGRCs. Different NPGRCs are at different levels and they can help each other if they are able to meet and discuss their challenges. More needs to be done also in creating awareness about the genebank among the policy makers, especially in SADC so that they can better appreciate the value of work of SPGRC and NPGRCs. This will influence the policy maker to provide more funds to genetic resource activities.

The Director said they recognised the importance of the genebank, but resources are very limited to do more that they can support. He said that breeders value the collections and have bred a witch-weed resistant variety (*Striga* resistant) for cowpea using a local landrace from the genebank. Farmers are also very interested in their collections and 107 farmers have made request to obtain materials from the genebank. Also, student from University of KwaZulu Natal has recently requested materials for MSc degree project.Other universities in Botswana are also major users of their germplasm for research purposes. The Director also said that SPGRC has also supported activities on on-farm conservation. A training workshop was held and seed fairs organised. Farmers are really interested in these activities and the recognition that they get about the local varieties. They need more of that that kind of support. The Director also said that there is a need to look at donor agencies to support the SPGRC network and the regional genebank and also fund regional projects given the wide diversity of agroecological zones present within the region. The head of the SPGRC should endeavour to focus on resource mobilization.

Visit to NPGRC genebank: The genebank is located within the Department of Agricultural Research. The curator of the genebank, Mr Gwafila, explained that their facility is composed of a laboratory, a package room, a drying room, a cold room and freezer room. They have 5 staff working in the NPGRC, (2 professionals, and 3 technical assistants). He says that he also carries out collecting both of cultivated and wild native species. He remarked that it is difficult to get adequate quantities of CWR species; as such species sets few seeds.

Storage facility: The genebank has 10 original Swedish upright freezers still in operation and 3 additional new freezers. Air conditioners in the freezer room are not working and temperature is rather high. A technical assistant daily checks the functioning of the freezers but does not kept a log of the checks. It was noted to them that they should keep a log of the all the activities. In addition, they also have a cold room in the freezer room, where most of the collection are kept. The cold-room is normally set at -5C but was showing +3C due the elevated temperature in the freezer room. Accessions are organised on fixed shelves

according crops. The layout is fixed shelves around the walls and a centre island of fixed shelf. The lab is well equipped with the basic genebank equipment and has a germinating cabinet that is functioning. However, they have a problem with their dryer. It has not been working for over a year and they are still trying to fix it. The dryer in question is the one originally donated by Sweden. They are coping by drying under shade and are able to bring the seeds to desired moisture content for conservation. The genebank does not have any Standard Operating Procedures (SOP) for their routine genebank work. The curator indicated that they follow IPGRI standards descriptors for multiplication and characterisation.

Seeds multiplication: The issue of seed multiplication at SPGRC or at NPGRC was discussed. The curator said this issue had been discussed on planning meetings and it is preferred to have multiplication done within the country of origin. However not all countries have resources to do it and sometimes requests SPGRC to do their seed multiplication. Botswana NPGRC has sent a batch of seeds to SPGRC in 2001 for multiplication.

Documentation: The NPGRC has been using the SDIS (old version) to document their data and have now shifted to the new web based SDIS. They are happy with it, in that it is easier to use, but complained that the web version does not contain all the information that previous version had. New system does not have characterisation data fields from some crops that they work on and absence of collector number. The SDIS system currently only shows 1031 accessions when they should be more than 3000 accessions. SPGRC staff uploaded this data. There is a lot of missing information as they have over 3000 accessions in the genebank. These data should be on the old SDIS version.

Main challenges: Their major constraint is staff shortage. He is the most experienced, having over 10 years working experience in the genebank. Others are relatively new staffs that have not had any formal training on PGR conservation.

Mauritius NPGRC

Meeting with the Assistant Director of Agricultural Service in Reduit, Mauritius: The consultant Ehsan Dulloo met with Mrs Neeta Leckraj, Assistant Director, Agricultural Services, Ministry of Agroindustry and Food Security in company with Senior Scientific Officer Mr Yacoob Mungroo, who is responsible for NPGRC activities within the Ministry.

The Assistant Director said that the ministry values the work of the NPGRC unit and that funding is not always a limiting factor. She said that resources can be mobilised, provided the unit make the request with their justification. She enquired whether there is also possibility for getting support for acquiring biotechnology for conservation work. She indicated that their human resources are limited and they suffer from very frequent staff movements between divisions and unit within the Ministry. The Assistant Director was previously working in Phytosanitary division and we discussed the issuance of phytosanitary certificate for movement of germplasm. She indicated that these are normally resolved within a week if the materials are clean.

Visit to NPGRC genebank in La brasserie, Curepipe, Mauritius: The genebank is located at the Labrasserie Agricultural Services station in Curepipe in Mauritius. This location is not ideal for a genebank as it is an area that suffers from high humidity for most of the year. The current curator is Mrs B. Mungra and she is assisted by one lab attendant and supported by two general workers. Mr Riyaz Allamamaly a technical assistant who takes care of the field genebank located at another site at Nouvelle Decouverte was also present. He is supported by 1 senior technical officer, an agricultural clerk and several general workers to help in the activities of the field genebank.

The seed genebank is very much under staffed and suffers significantly from frequent replacement of staff. Trained staff often leaves NPGRC for other divisions in the ministry. Mrs Mungra has not had a proper formal training in PGR conservation, although she has benefitted from 2 short training workshops by CIRAD Reunion and SPGRC. In addition, the staff of NPGRC (Mrs Mungra and Mr. Allamamaly) have received training by the SPGRC

Senior programme officer (documentation) on documentation system for implementing SDIS in Mauritius.

Genebank facilities: The genebank is housed in a brick walled building covered with iron-corrugated sheets. These sheets are getting rusty and will soon be replaced. Mrs Mungra explained that their genebank facility has only 2 rooms, an office (also used for documentation) and a seed laboratory where all the seed processing, moisture content determination, drying and germination testing are done. The genebank has 8 freezers (maintained at -18deg C) originally obtained through the SPGRC/Nordic programme and are still functioning well, although they are starting to get some problems with two of them. In one freezer, ice is starting to accumulate. They use aluminium foil bags to store their seeds and these are placed in plastic boxes (tupperware). Each shelf can only take 2 boxes, and a lot of space is wasted. Currently all freezers are used and there is no spare freezer in case one breaks down. Consultant advised that they need to review the sizes of the container boxes so as to get at least three appropriately sized boxes that can fit on one shelf and this will increase their capacity further. In this way one or even two freezers could be liberated and serve as the spare freezers.

In effect therefore, the NPGRC are conserving their seeds under long-term conditions. Most of the genebank equipment were donated by the SPGRC/Nordic programme. The drying oven (Munthers) and moisture analyser are not working. These need to be replaced. Currently seeds are dried in cotton bags placed in desiccators. When weather permits they are dried under shade in the building veranda. The curator is using the oven method to calculate the MC of seeds. The lab also does not have air conditioning but has two humidifiers of which only one is working. The germinator cabinet is functioning well. They also have an electronic balance (3 decimal digit accuracy), pH meter, binocular microscope, and foil sealers. There is no light table and desk lamp for sorting seeds. No distilled water apparatus is available. There are no written Standard Operating Protocols for the different genebank activities. These need to be developed in collaboration with SPGRC.

Documentation: The NPGRC was provided with SDIS documentation system by SPGRC. As mentioned above SPGRC Senior Programme officer (Documentation) has installed the system on their computers and trained the staff on its use. Despite this, it was evident from the visit that the staff could not use the system properly. The accession records are kept on a master copy Excel file. They also have many ledgers that keep information on accessions that are sent out to the field for multiplication and another ledger for incoming accessions. There is an urgent need to build/strengthen capacity of the curator and lab attendant in genebank documentation and ensure that the all genebank information are properly documented in the SDIS and properly back up.

Sending seeds to SPGRC: Mr Mungroo explained that accessions to be backed up at SPGRC are processed in Mauritius and are packed in Aluminium bags to be sent to SPGRC. Each consignment consists of 5 Al bags with 50 seeds for viability monitoring and the rest in larger Al bag for long-term storage. The passport information as well as seed viability test are sent together with the seeds. However, it also happens that consignment get held up in Customs and then SPGRC need to do a germination test to test their viability. However, so far, the NPGRC never received any feedback from SPGRC on their accessions be it about the result on viability tests or on other issues related to their accessions stored at SPGRC.

Multiplication and characterisation: The NPGRC in Mauritius has access to 5 different agricultural stations in different of climatic zones for multiplication and regeneration. NPGRC unit send their seeds for multiplication and regeneration, under the care of the Senior Technical officer in charge of the station. In discussing with the team, it seems that they prefer to do the multiplication work in Mauritius, in most appropriate climate conditions as the origin of the accession. They always send enough seeds to SPGRC, although SPGRC has been requesting less seeds from them. The centre does not systematically carry out characterisation of their accessions due to lack of trained human resources capacity.

Distribution of germplasm from NPGRC genebank: The genebank has a very small collection (538 accessions). Since 2104 they have received only 3 requests from Rodrigues islands, seed unit in the Horticulture division and from Food and Agriculture Research and Extension Institute (FAREI) for germplasm. In Rodrigues germplasm of local variety of capsicum (Ti Piment Rodrigues) was lost in Rodrigues after a cyclone. NPGRC received requests from Rodrigues for repatriation of 5 accessions of the 'Ti piment' Rodrigues variety. These were repatriated twice in 2014 and were multiplied and used there for the project 'Village Ti Piment'. The NPGRC also received requests from the seed unit of the Horticulture division for commodity like beans, lettuce and tomato in 2016 for seed production and ultimately put on sale to planters and general public. FAREI also requested for accessions for research purpose (e.g. Carrot, winged bean and pigeon pea) in 2016. Seeds accessions from the genebank were sent to use in their trials. So far, no feedback received on the outcome of the research.

Challenges: The major constraint is the high turnover of staff in NPGRC. The genebank also suffers from heavy administrative procedures which sometime takes long for timely distribution of seeds, even at the National level. The state of some of the basic equipment such as dryer is running down and need to be replaced.

Annex 4: SPGRC/Global Diversity Trust Review Draft Program

DAY	TIME	ACTIVITY	AREAS COVERED	FACILITATOR
DAY 1 Monday 20/11/2017	08:00 – 08:20 08:20 – 08:40	Guests arrive at SPGRC Introductions		
	08:40 – 09:00	Welcome and General Introductions to the SPGRC	Overview of the SPGRC Network in brief	Justify Shava
	09:00 – 09:30	Brief presentation by the Review panel Chair and Q&A to all relevant staff including senior management	Clarification of the objectives of the mission	Ehsan Dulloo
	09:30 – 10:30	**TEA BREAK**		
	10:30 – 13:00	Tour of the genebank facilities in the field and laboratory	Appreciation of the available PGR Conservation infrastructure	Justify Shava
	Meeting with Relevant Theme Leaders			
	14:00 – 15:00	Meeting with the Head	General Matters pertaining to the SPGRC	Ehsan Dulloo
	15:00 – 16:00	*Ex Situ* Conservation		Lerotholi Qhobela (SPGRC) and the Evaluator
	16:00 – 17:00	*In Situ* Conservation		Thandie Lupupa (SPGRC) and the Evaluators
DAY 2 Tuesday 21/11/2017	08:00 – 13:00	**Visit to the Zambia National Plant Genetic Resources Centre**	An overview of the operations of the SPGRC Network at National Level	
	13:00 – 14:00	**LUNCH**		
	14:00 – 15:00	Documentation and Information	Data and Information Management	Barnabas Kapange (SPGRC) and the Evaluators
	15:00 – 16:00	Finance Unit	Financial Management Issues	Florence Chitulangoma

DAY	TIME	ACTIVITY	AREAS COVERED	FACILITATOR
				(SPGRC) and the Evaluators
	16:00 – 17:00	HR and Admin	Human Resources, Risk Management & Quality Management Matters	Mary Bianca Phiri (SPGRC) and the Evaluators
DAY 3 Wednesday 22/11/2017	08:00 –10:00	Review of any outstanding issues with gene bank		
	10:00 – 10:30	**TEA BREAK**		
	10:30 – 13:00	Compilation of Report		
	13:00 –14:00	**LUNCH**		
	14:00 –16:00	Meeting with Senior Management	Review Feedback	Ehsan Dulloo
	16:00 – 16:20	Acknowledgements		Justify Shava
	16:30	Meeting Ends		All

Annex 5: Recommendations of Mr Matija Obreza (Crop Trust) Mission report (2015) and responses from SPGRC as at January 2018.

1. SPGRC should **consider installing temperature sensors** in all freezers and record the temperature data using a computer system. This will allow for continuous monitoring of freezers and could be used to generate alerts in case of failure. The system should not be fixed to the current number of freezers, but extensible for any future additions.

   Temperature sensors are not yet installed in the genebank although plans are underway to have them installed. A computer system to monitor the freezers will be developed and installed after the temperature monitor gadgets have been put in place.

2. SPGRC should **continuously work on improving record keeping** at the base collection and in NPGRCs. Current documentation practices in the region are a mix of Excel, SDIS and paper forms. Documentation and Information unit should assist all genebanks with best practices in documentation and provide support in compilation of databases. Compiled databases provide valuable source from which new knowledge about the collections can be generated.

   Documentation on collected materials used to be registered manually. This has now been changed with all information on collections being done electronically on computer through an added module on SDIS. Information on assets, genebank personnel (names, positions, qualifications, trainings, etc.) is available electronically and therefore can be accessed and shared fast and efficiently.

3. SPGRC should **enhance the level of information systems and documentation support** to the gene bank and aim to properly capture and computerize data generated in genebank operations in a way that does not slow down the workflows. The Documentation and Information unit should at all times, know precisely what is maintained in the base collection with all associated information on accession status.

   This weakness is acknowledged. The reorganization has started already where the Documentation and Information officers will spend more time working with the gene bank. To date the DOS version of SDIS on computer used by the Technical Officer (Ex-Situ) at SPGRC was maintained to only facilitate printing of labels. However, with the new printing facility embedded on web-SDIS, printing has been simplified and is done directly from the system at both regional and national levels. The Technical Officer (Ex-Situ) at SPGRC has been inducted and migrated to new web-SDIS. The system generates numerous reports on materials and activities conducted over a period.

4. SPGRC should **lead-by-example** when it comes to information systems for gene bank documentation. Documentation and Information unit should primarily support the data management of the base collection. Best practices for documentation can then be showcased and promoted in the region. This could improve the use of SDIS at NPGRCs and facilitate for better sharing of information with the community.

   Internationally agreed standards for genebank record keeping have long been in use in gene banks around the World. SPGRC and the community have already adopted the use of standard crop descriptors published by Bioversity International and from other publishers as and when needed by users. Scientists are encouraged to develop descriptors for local indigenous crops whose descriptors have not yet been developed. There is, however, room for improvement in the manner in which Documentation and information Unit has been doing its work in the past. There is re-organization taking place so that Documentation and Information do more to support the genebank programs and activities.

5. Accession passport data should closely follow, if not match, the **Multi-Crop Passport Descriptors**. SPGRC should ensure that MCPD standard is used at the core of passport

documentation. It should reflect on the paper forms, in compiled databases and any information system.

With the web-based SDIS the system is trying as much as possible to capture and align to MCPD. More still needs to be done though to realise the benefits of the use of the MCPD.

6. SPGRC should **secure the ownership** of the software developed by any outside entity. This will allow SPGRC to independently maintain the system and engage other partners in future improvements.

   Software is under ownership of SPGRC. The SPGRC will engage the legal unit of SADC to ensure that the deals are strictly beneficial to SPGRC. Strategies have already started to be put in place to ensure total control of the software and operations done for SPGRC by outsiders.

7. Information systems introduce a level of complexity to the documentation processes in genebanks. In order to minimize these effects, any information system should closely **follow the workflows** of standard operating procedures in genebanks and be user-friendly.

   This is a point taken. Any future projects in information systems will be evaluated for suitability to current workflows and made in a simple manner to allow quick adoption.

8. **Frequent interactions** between the developers and documentation experts are necessary to ensure the end-product matches expectations and that the project stays on track.

   SPGRC has published its accessions on Genesys PGR portal. There is continuous interaction between developers and documentation staff and users to ensure each party's interests are captured and implemented. More needs to be done in this regard, however.

9. SPGRC should consider joining the international PGR community in **publishing accession-level information on Genesys** PGR portal. This would present SPGRC as the regional leader in genebank documentation and allow researchers and decision makers around the World to find information about SPGRC base collection along with the information from CGIAR genebanks, USDA, EC/PGR and others.

   At the time, Matija Obreza visited SPGRC the website was indeed being upgraded thus inaccessible. It has since been available and has assisted in promoting the network. We are even improving its accessibility to the world community of plant genetic resources conservationists.

10. It is recommended that SGPRC **ensure its website is always operational** and that in case of upgrades provides basic information about the organization with links to other on-line resources about SPGRC (e.g. the SADC website and potentially Genesys).

    The website has links to other partners and is kept updated as frequently as possible to capture new developments and events. There may be some accessibility challenges, but we are working on them so that the website is up all the time.

THE GLOBAL CROP DIVERSITY TRUST
Platz der Vereinten Nationen 7
53113 Bonn
Germany

MEDIA CONTACT
publications@croptrust.org

GENERAL CONTACT
info@croptrust.org

CROP TRUST