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Salvaging early generation seeds and enriching germplasm collection at the Genetic Resources Research Institute in Kenya

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Abstract

In Kenya, plant genetic resources are mainly conserved by Genetic Resources Research Institute (GeRRI). The institute (formerly known as the National Genebank of Kenya) has to date amassed slightly over 51,000 (fifty-one thousand) accessions. Recently, GeRRI sought to forestall loss of germplasm in the hands of plant breeders/researchers from various local institutions. This was achieved by reaching out to these researchers and securing genetic materials i.e. advanced selections, breeder, pre-basic or basic seeds that need conservation. In addition, GeRRI sensitized the researchers on the existence of its conservation facilities which can be utilized to safeguard research materials. Visits were made to KALRO centres and local universities to enlighten the researchers/lecturers on availability of conservation facilities at GeRRI and to develop terms of engagement concerning depositing of seeds for safe custody. During the visits, a short questionnaire was administered to researchers by the GeRRI team. The questionnaire helped in gathering information about the various activities the researchers were engaged in, their understanding of GeRRI and her facilities as well as the services she offers. Only about 28 % of KALRO respondents have ever requested seeds from GeRRI compared to 42 % from the universities. These low percentages could be due to the fact that some researchers are not aware of the germplasm holdings at GeRRI and/or the process of requesting for the seeds. In addition, fewer respondents (about 17 % from universities and 8 % from KALRO centres) have ever deposited their seeds with GeRRI previously. Most local researchers keep their orthodox seeds in stores in paper bags/gunny bags/plastic bottles at room temperature. This leads to rapid seed degeneration and increases the need for frequent regeneration. Both KALRO and university researchers lauded GeRRI for organising collection of these early generation seeds and also requested the institute to undertake similar activities regularly.

Keywords: Early generation seeds, Genetic Resources Research Institute, Plant genetic resources conservation.

Introduction

Biodiversity (biological diversity) is the variety and variability of life on earth, in all its forms and interactions. It is a measure of variation at the genetic (genetic variability), species (species diversity), and ecosystem (ecosystem diversity) level. Genetic resources mean genetic material of actual or potential value i.e. any material of plant, animal, microbial or other origin containing functional units of heredity. Plant genetic resources are the genetic material of plants, which is of value for present and future generations (Murray, 2017); plant material with a current or potential value for food, agriculture and forestry (Brockhaus and Oetmann, 1996). They consist of diversity of seeds and planting materials of traditional varieties, modern cultivars, crop wild relatives, and other wild plant species and are used for food, feed for domestic animals, fibers, textiles, and energy (Ferranti, 2016). They are the biological basis of food security and are utilized in research to develop new high yielding and resilient crop cultivars for enhanced agricultural production (Noss and Cooperrider, 1994; Hammer and Teklu, 2008). These resources however continue to face imminent loss through genetic erosion occasioned by both biotic and abiotic factors. The evident cause of genetic erosion is the diffusion of modern varieties from crop improvement programs (Brush, 1999); with the development of scientific plant breeding, high-quality and homogenous new cultivars were quickly and widely distributed suppressing landraces. Landraces adapted to optimal local agronomic conditions are probably the crop plant genetic resources that are most at risk of future loss through habitat destruction or by being replaced with introduced elite germplasm (Brush,1995). In addition, population growth, urbanization, developmental pressures on the land resources, deforestation, changes in land use

Table 1. Number of respondents who filled the questionnaire from the institutions visited.

University	No. of respondents	KALRO Centre	No. of respondents
Maseno University	2	Kisii	2
Rongo University	6	Kitale	4
Egerton University	2	Kakamega	4
University of Kabianga	2	Lanet	2
Jaramogi Oginga Odinga University of Science and Technology (JOOUST)	1	Perkerra	2
Masinde Muliro University of science and Technology (MMUST)	2	Njoro	2
Kibabii University	4	Mwea	6
Moi University	5	Thika	3
University of Eldoret	5	Matuga	2
Taita Taveta University	**1**	Mtwapa	3
Pwani University	**1**	Kiboko	2
Kenyatta University (KU)	**1**	Msabaha	1
South Eastern Kenya University (SEKU)	**1**	Embu	1
Chuka University	**1**	Katumani	2
University of Embu	**1**		
Meru University of Science and Technology	**1**		
TOTAL	**36**		**36**

patterns and natural disasters such as frequent droughts and floods are contributing to abundant habitat fragmentation and destruction of the crops and their wild relatives. Droughts of just a single season could result in people consuming seed stocks, while successive years of drought can prompt changes in cropping patterns and the geographic distribution of crops (Erskine and Muehlbauer, 1990); the situation is worsened by global warming. Urgent action is needed to collect and conserve these irreplaceable genetic resources (Frankel, 1974). Effective conservation and use of plant genetic resources is therefore critical if we are to realize food and nutrition security, agricultural resilience and economic growth (Hammer and Teklu, 2008). However, even plant genetic resources held *in situ* (held in their natural ecosystems) and the *ex situ* collections (those held in conservation facilities of individual institutions or in the hands of researchers/breeders) face risk of genetic erosion. With *ex situ* collections, genetic erosion could be due to lack of effective conservation facilities in the respective organizations and/or lack/inadequate resources for effective and timely regeneration of the conserved materials. Plant genetic resources in the hands of researchers can also be lost due to improper handling and storage or through natural attrition of researchers particularly when proper handing over is not secured.

In Kenya, plant genetic resources are mainly conserved by Genetic Resources Research Institutes (GeRRI). The institute (formerly known as the National Genebank of Kenya or simply genebank) has a national mandate to conserve the country's genetic resources. It is one of the sixteen semi-autonomous institutes of the Kenya Agricultural and Livestock Research Organization (KALRO) established through the Kenya Agricultural and Livestock Research (KALR) Act in 2013 (Kenya Gazette Supplement Acts, 2013). The National Genebank of Kenya was mandated to conserve germplasm of crop plants and their wild/weedy relatives so as to prevent genetic erosion. With establishment of GeRRI, the mandate was expanded to also conserve biodiversity of animals, microbes, insects and arthropods. Despite its expanded mandate, GeRRI is currently concentrating on conserving plant genetic resources because the physical and human infrastructure to handle animals, microbes, insects and arthropods have not yet been put in place. In delivering this expanded mandate, GeRRI has to date amassed slightly over 51,000 (fifty-one thousand) accessions (ecotypes) comprising over two thousand plant species, a majority of which are crop plants. This rich collection include materials collected locally and from other countries globally. Almost all these accessions are conserved *ex situ* in cold rooms at - 20^0C for long term conservation and +5^0C for short term while a few non-orthodox seeded and clonal crops are conserved in field genebanks.

Recently, GeRRI sought to forestall further loss of plant genetic resources in the hands of local researchers. To achieve this, GeRRI reached out to plant breeders/ researchers in various local organizations so as to secure genetic materials i.e. advanced lines, breeder, pre-basic or basic seeds that need long-term conservation. Funds for this undertaking were provided through the World Bank project, Kenya Climate Smart Agriculture Project (KCSAP). The KCSAP was focusing on sorghum, fingermillet, greengram, cassava, irishpotato, pigeon pea, banana, tomato, bean and African leafy vegetables value chains.

The GeRRI team decided to first determine availability of early generation seeds from KALRO centres and local universities where research on crop plants is undertaken. In addition, GeRRI wanted to determine the extent to which local researchers know about her conservation facilities, operations and germplasm collection held there. To achieve this, visits were made to the targeted institutions and researchers were sensitized on the importance of conserving their working germplasm in the facilities at GeRRI. The visits were also meant to explore possible collaboration between GeRRI and the institutions in areas of plant genetic resources conservation and sustainable use. After this activity, available early generation seeds were collected from these institutions

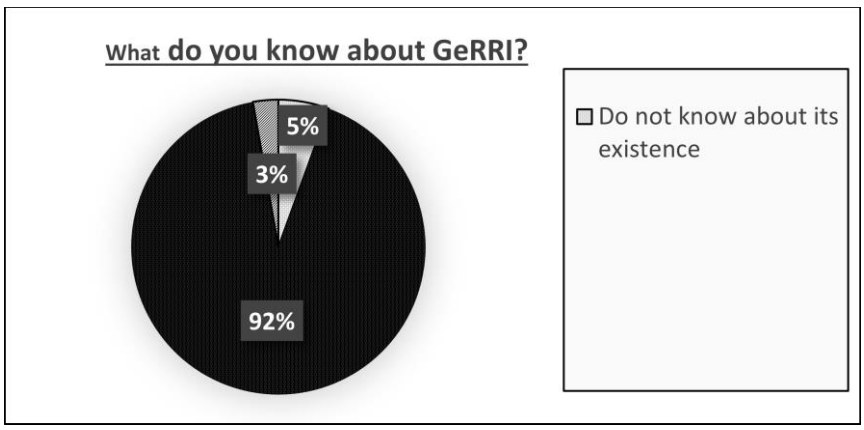

Figure 1. University respondents' knowledge about GeRRI.

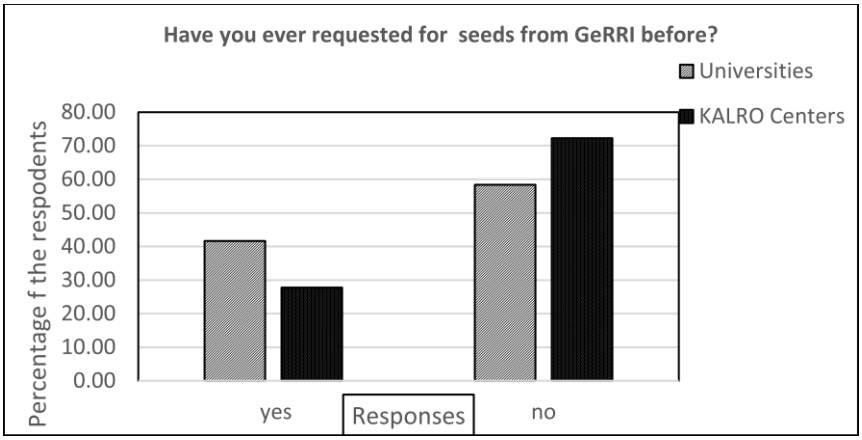

Figure 2. Percentage of respondents who have requested seeds from GeRRI previously.

for conservation at GeRRI. Reported here is the outcome of this undertaking using the money provided by KCSAP.

Results and Discussion

Sensitization on germplasm conservation and determination of utilization

From the universities that were visited, a total of 36 questionnaires were filled while the same number of respondents were recorded at KALRO centres (Table 1). From KEPHIS Lanet there was one respondent. Team 1 from GeRRI decided that only one respondent from each university they visited should fill the questionnaire while team 2 allowed all the available staff to respond. From the universities, majority of the respondents (92 %) rightly indicated that GeRRI (previously known as the genebank) is an institution for conserving plant genetic resources, mostly landraces and wild types as well as other endangered plant species (Figure 1). This correct response from the universities could be because most of these researchers/lecturers either previously worked with KARI (the precursor of KALRO) and/or had previously accessed materials from GeRRI. A good number of the respondents could have gotten an idea from the introductory letter GeRRI wrote to these universities before the actual visits were made. However, most respondents appeared unaware of the expanded mandate of GeRRI. This could be because GeRRI has made little effort in publicizing herself. For those who have visited the institute, they do not see any difference between genebank and GeRRI in terms of physical facilities and operations.

Only about 28 % of KALRO respondents have ever requested seeds from GeRRI compared to 42 % from the universities (Figure 2). This low percentage of seed requests by both KALRO and universities respondents could be due to the fact that some researchers are not aware of this service offered by GeRRI. There is also a misconception as most researchers wrongly believe that GeRRI only conserve wild germplasm. These low seed requests could also be due to the fact that most local plant researchers do not have access to information on germplasm holdings at GeRRI and/or the process of requesting for the seeds. A previous study showed that more researchers from National Agricultural Research Institutes (NARIs) requested seeds from the National Genebank of Kenya compared to those from universities (Mutegi et al., 2006). In that study, the investigators also found low level of seed requests from the genebank by local researchers generally; this corroborates with the current observation. Another report showed that the overall utilization of the germplasm conserved at the National Genebank of Kenya has remained relatively low; only 4,000 of the more than 49,000 accessions conserved (8.16 %) had been distributed in the previous 15 years (Wambugu and Muthamia, 2009). Other researchers found that exiguous use of conserved germplasm by the breeding programs is mainly due to lack of information on economic traits of the

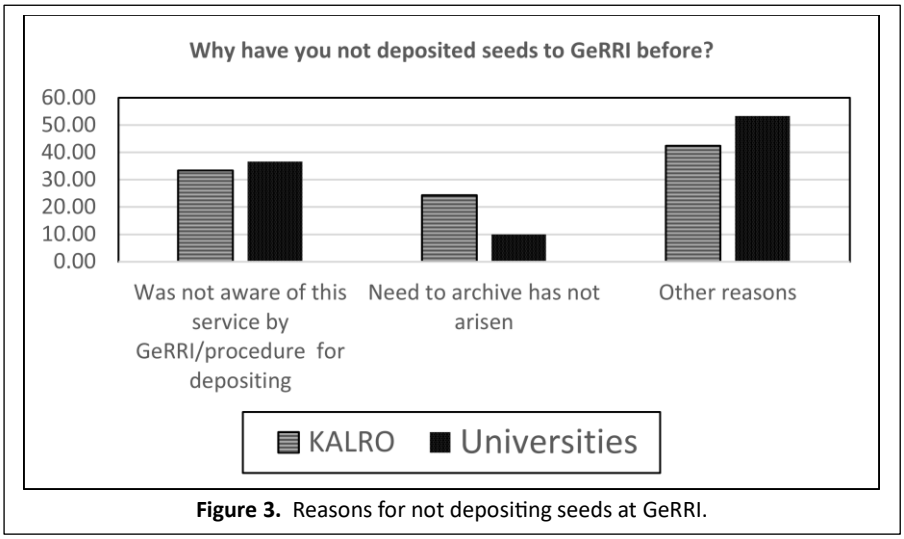

Figure 3. Reasons for not depositing seeds at GeRRI.

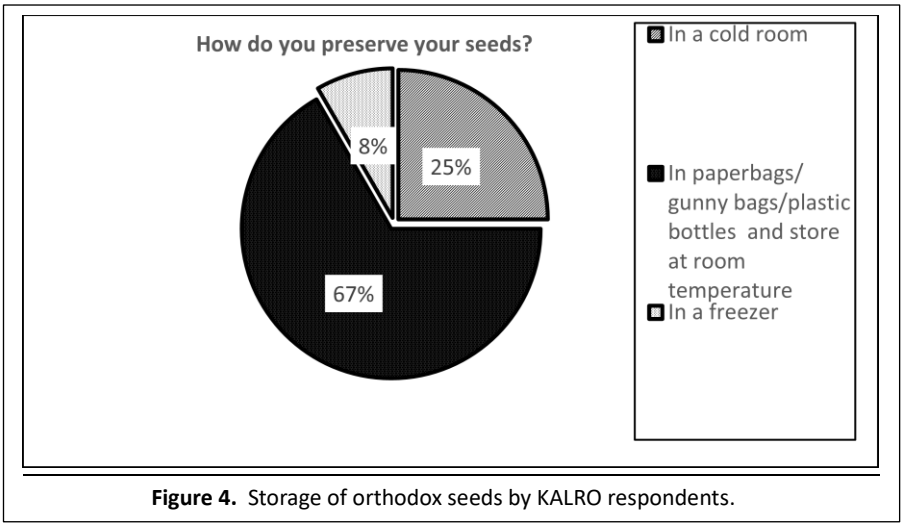

Figure 4. Storage of orthodox seeds by KALRO respondents.

conserved germplasm (due to inadequately characterization and/or evaluation of available germplasm) and minimal exchange of data (Upadhyaya and Gowda; 2009; Khoury et al., 2010). Fewer respondents (about 17 % from universities and 8 % from KALRO centres) have ever deposited their seeds with GeRRI previously. This could be because they don't know GeRRI offers this service, they do not know the procedures for depositing seeds, do not trust GeRRI can keep their seeds safe or they have not generated planting materials that need conservation. Of those who have never deposited seeds at GeRRI from both KALRO centres and universities, over 30 % of them cited lack of awareness of the existence of this service offered by GeRRI and/or ignorance of the procedures for depositing the seeds (Figure 3). A smaller percentage indicated that the need for conserving the seeds had not risen possibly because their breeding programs are relatively new and have not generated seeds. Other reasons given include that the respondents are not involved in plant breeding work at all and therefore do not generate seeds. A number of respondents, mostly from universities, also indicated that the seeds end up in the hands of their students and hence have little control. In universities where active plant breeding has been going on, most lecturers/researchers indicated they generate a lot of germplasm with their students but they lack good storage facilities and/or they don't know how to conserve the seeds properly. This called for regular regeneration of seeds which is an expensive undertaking. Consequently, the breeders have been losing a lot of seeds especially in the segregating generations as research funds are not always guaranteed. The same story was repeated in KALRO centres.

Most of KALRO researchers indicated that they keep their orthodox seeds in stores in paper bags/gunny bags/plastic bottles at room temperature (Figure 4). In these stores the researchers have no control over temperature and relative humidity. The researchers said they incurred heavy losses as seeds lose viability fast. They expressed regrets over lost opportunities and the fact that they have lost a lot of their breeding materials over time. For those dealing with clonal crops, they indicated they faced problems in getting a good institution where they could duplicate the materials *in situ*. About 50% of the respondents from the universities indicated they are working on food crops (Figure 5). This high percentage could be because most researchers work on more than one crop species concurrently through their students. In addition, there is a wide range of food crops to work on. It could also be that food crops are given higher priority in research as it is in the agriculture sector generally. A similar scenario was evident in KALRO centres (Figure 6). In KALRO, food crops research institute (FCRI) is the largest in terms of human resource capital compared to other institutes. The great importance of food crops research in

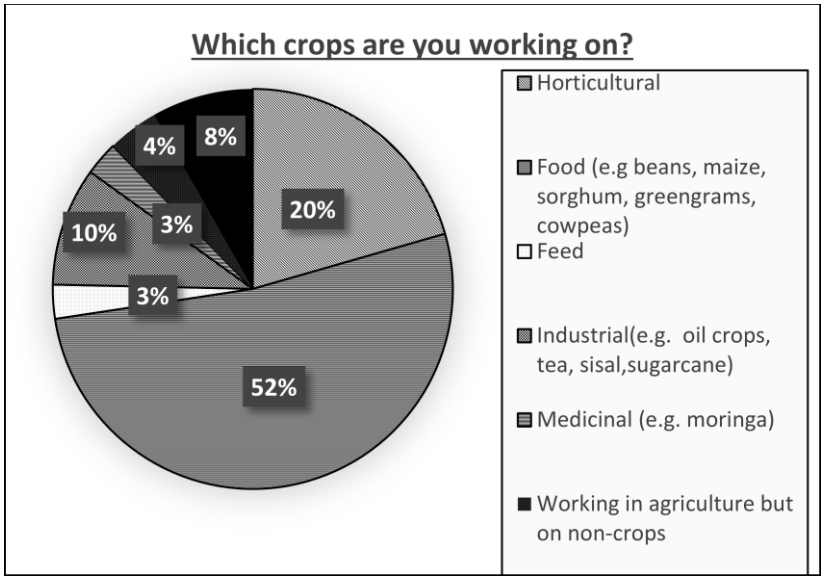

Figure 5. Range of crops various respondents from universities are working on.

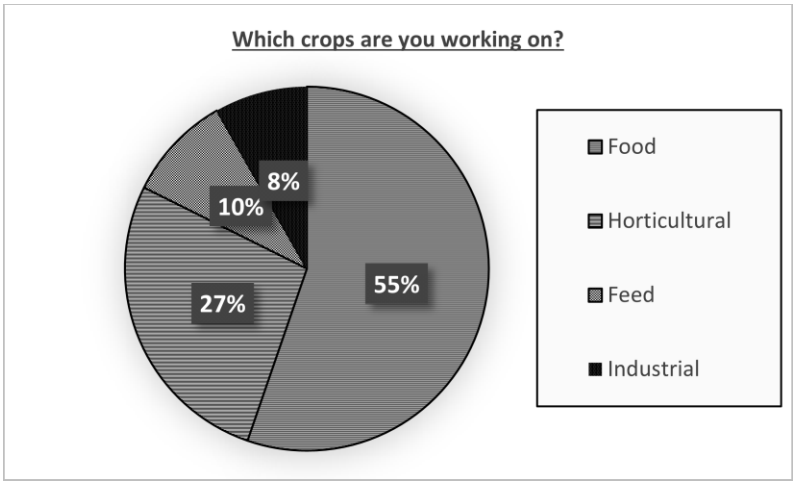

Figure 6. Range of crops various respondents from KARLO centres are working on.

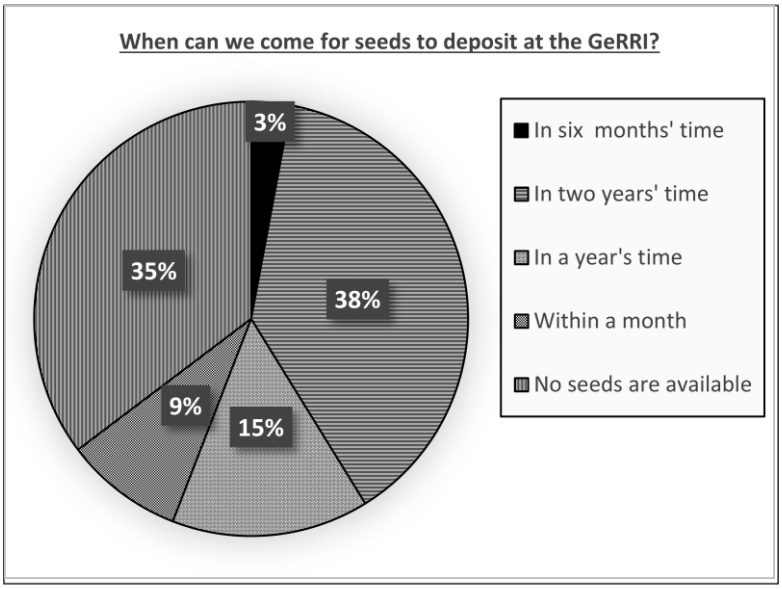

Figure 7. Percent of respondents from universities who have ready seeds for depositing at GeRRI.

Table 2. Areas of possible collaboration between GeRRI and various local universities

Areas of possible collaboration	University
Collaborative collection, conservation, multiplication and exchange of germplasm, and genetic diversity studies.	Rongo, JOOUST, Moi, Pwani, Taita Taveta, KU,SEKU, MMUST, Meru University, Chuka University, Embu University, Maseno University, University of Eldoret, University of Kabianga
On-farm (*in-situ*) conservation of vegetatively propagated crops where GeRRI could duplicate them and vice versa	Rongo, Moi
Evaluation of materials conserved at GeRRI where superior accessions identified would be given to farmers for their own use. Advanced characterization and crop Improvement	Rongo, Maseno, University of Kabianga, University of Eldoret, Moi
Exploration of other conservation strategies for vegetatively propagated crops such as in vitro conservation, cryopreservation.	Rongo (has a functional TC lab)
Extensive collection, proper identification, conservation and diversity studies of locally available indigenous medicinal plants (for human and animals) especially from Mt Kenya, Mt Elgon and Kakamega forests as well as other neglected and underutilized crop species such as rice beans, bamboo, moringa	Rongo, Kibabii, University of Eldoret, Moi
Enhancing the researchers' access to germplasm from GeRRI.	Maseno, Egerton University
Training and capacity building in germplasm handling, short and long term conservation to the University breeders/researchers.	MMUST, Egerton University
Establishing and populating/enriching community seed banks	Masinde Muliro, Egerton University
Rehabilitation of degraded lands using plant species that can do well in such areas.	University of Kabianga,
Developing joint proposals for sourcing funds	University of Kabianga, University of Eldoret, MMUST, Kibabii University, SEKU
Student attachment, academic visits, co-supervision and part-time/Adjunct lecturing	University of Eldoret, SEKU, MMUST, Kibabii, Moi, Meru University, Chuka University, Embu University
Establishment and/or enriching botanical gardens with medicinal and other useful plants.	University of Eldoret, Kibabii University, MMUST, Moi, SEKU, Chuka university
Initiate a Plant Genetic Resources training programme	SEKU

Table 3. Areas of possible collaboration between GeRRI and KALRO centres.

Areas of possible collaboration	KALRO Center
Germplasm characterization studies of genetic materials conserved by GeRRI to aid in identification of useful traits for crop improvement	KALRO Centres at Embu, Katumani and Kandara
Regular germplasm exchange	KALRO Centres at Embu and Katumani
Identification of germplasm that are resistant to pests and diseases	KALRO Centre at Mwea
Regular collection of early generation seeds from breeders and keeping them safely at GeRRI	KALRO Centres at Mwea, Kiboko, Kandara, Perkerra, Kitale and Kakamega. KEPHIS Lanet
Establishment and maintenance of field genebanks for clonal and un-orthodox seeded crops	KALRO Centres at Mtwapa, Matuga, Njoro and Msabaha
Conservation of plant genetic resources *in-vitro* and as field genebanks	KALRO Centre at Kandara
In seed bulking	KALRO Centre at Perkerra

Kenya could be due to the fact that as a country, food security is paramount. In Kenya, the agriculture sector is heavily relied upon to ensure the country attains and remains food secure (MOALF, 2019). Most food crops production systems in Kenya are rainfed and subject to vagaries of nature especially low and erratic rainfall. Consequently, research to develop and promote high yielding climate resilient food crops is given priority.

About 24 % of the respondents from universities indicated they were conducting plant breeding and crop improvement activities on the crops they are working on.

Over 60 % of the respondents from universities indicated they have seeds they could share with GeRRI for safe custody (Figure 7). However, almost all of them said they did not have the seeds at hand and that they needed time for germplasm assembly. This is because most of the seeds were in the hands of their students or in the field growing. The GeRRI team was advised to keep in touch with these researchers to collect seeds once they are ready. The only exceptions were from Egerton (1 breeder), JOOUST (1) and Rongo (1) who indicated they had beans, quinoa and cassava planting materials, respectively. These accounted for 9% of the respondents and the GeRRI team was advised to collect these planting materials within a month. However, one week later, the breeder from Egerton shied away and informed the GeRRI team he wouldn't share his materials. This change of mind was not a surprise given that during the visits, most university breeders appeared unconvinced about the sincerity and/or capability of GeRRI to conserve their seeds safely. They feared that GeRRI could distribute their seeds to other competing breeders. This could also explain why most university breeders indicated they did not have seeds to share with GeRRI immediately and/or do not have seeds at all. About 35% of the respondents indicated they do not have seeds/ do not generate early generation seeds (Figure 7). These researchers either are not involved in plant

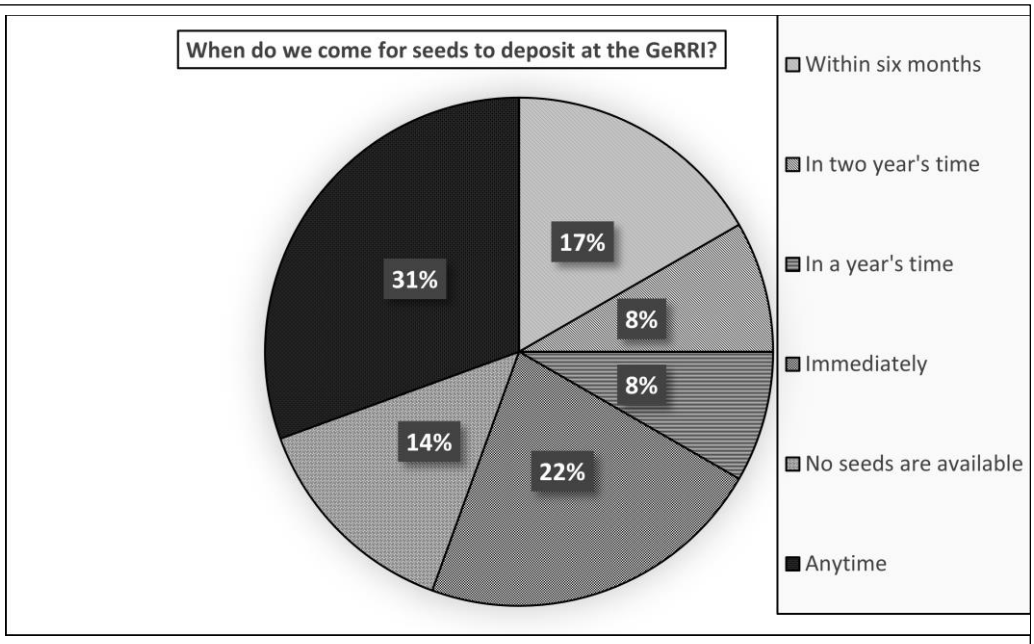

Figure 8. Percent of respondents from KALRO centres who have ready seeds for depositing at GeRRI.

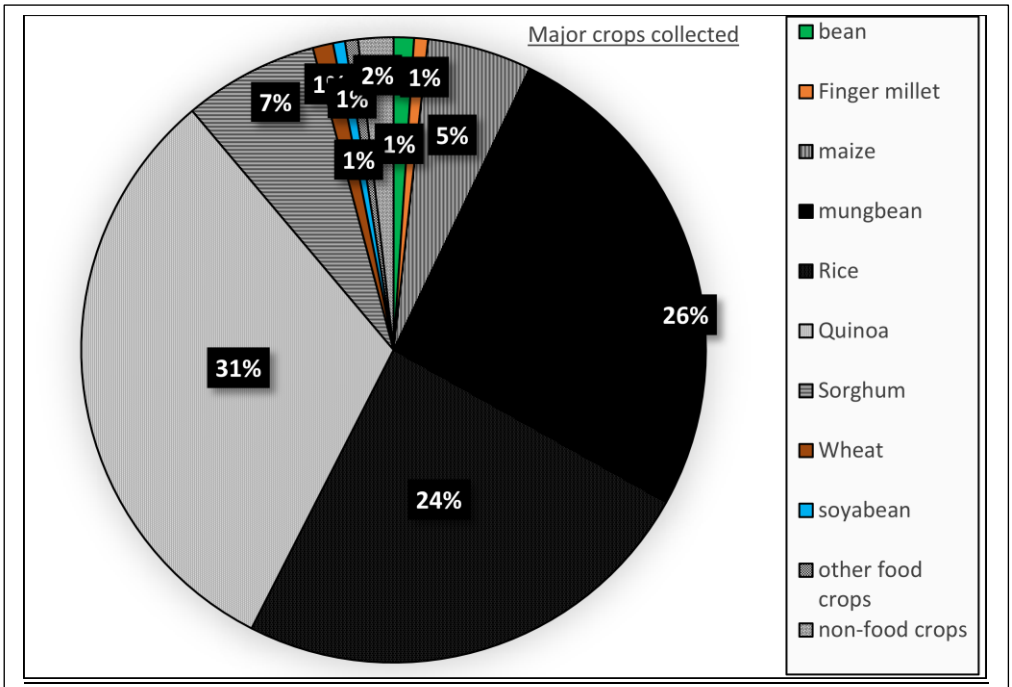

Figure 9. Percentage of seed samples collected

breeding activities, are entirely not in the field of agriculture or are administrators who hardly have time for research. For KALRO respondents, only 14 % indicated they do not have seeds (Figure 8). Most of those who indicated they could give seeds anytime (31 %) were dealing with clonal crops such as cassava and sweet potatoes which can be harvested anytime. Those with immediate seeds (22 %) gave the seeds to the GeRRI staff during the visits or they promised to give in one weeks' time.

Areas of possible collaboration

The universities identified a number of areas where they can collaborate with GeRRI (Table 2). Most universities expressed the desire to collaborate with GeRRI in collection, conservation and multiplication of plant genetic resources as well as in conducting genetic diversity studies. Other areas that elicited interest are collaboration in student attachment, academic visits, co-supervision and part-time/adjunct lecturing as well as in developing joint proposals for sourcing funds. In order to make these collaborative agreements more binding, researchers from Kibabii University and SEKU expressed a strong desire to sign a Memorandum of Understanding (MoU) between GeRRI and these institutions before embarking on any work. Kibabii University indicated they already have a MoU with the Veterinary Research Institute (VRI) of KALRO although not yet formalized. The

Table 4. Areas in which GeRRI was urged to improve in her operations.

Frequent collection and maintenance of germplasm from the researchers	KALRO Centres at Mwea, Katumani, Embu, Kakamega, Mwea, Kisii,Thika and Mtwapa
Create awareness so that the breeders and researchers can know what GeRRI holds, does and the benefits of depositing their materials at GeRRI	KALRO Centres at Katumani, Kakamega, Kisii, Msabaha, Kitale, Kakamega, Perkerra, Mwea, Njoro, Thika, Mtwapa and Kiboko
Digitization of all conservation data so that it is available to everyone easily. The data should be made available in the website.	Rongo University, Kibabii University
Involve the breeders when regenerating their accessions	KALRO Centre at Katumani
Collection and maintenance of germplasm from the farmers	KALRO Centres at Katumani, Embu and Mtwapa
Train bio scientists on seed handling and management at research stations	KALRO Centre at Kandara
Sensitize researchers on how they can use materials stored at genebank	KALRO Centre at Kandara
Create awareness on the germplasm stored in the genebank through a website and other public platforms such as field days, conferences, exhibitions	KALRO Centres at Embu, Perkerra and Njoro. University of Eldoret, MMUST, Kibabii University, Moi University
Passport data or minimal characterization data should accompany seed samples during distribution	KALRO Centre at Embu, University of Eldoret
Routine follow-up of field genebanks at commodity Centres	KALRO Centre at Matuga

general feeling was that the MoU should be signed between the University and KALRO Headquarters. Researchers from SEKU felt that the material transfer agreement (MTA) currently used by GeRRI is too broad; they needed a more specific one for their institution.

Various KALRO researchers identified areas of possible collaboration with GeRRI (Table 3). Most KALRO researchers expressed a need for regular collection of breeders' materials from the centres for safekeeping at GeRRI to curb genetic erosion. This is because most KALRO centres lack cold rooms for long term seed storage. In instances where cold rooms are available, some researchers lack the know-how on proper seed handling and storage.

Genetic Resources Research Institute was challenged to advertise themselves seriously through various platforms such as field days and website so that other stakeholders can know the germplasm collection they have, what they do and the services they offer (Table 4). Previous research has shown that lack of access to information on seed holdings at the Kenyan genebank is the major constraint to effective utilization of the conserved germplasm (Mutegi et al., 2006). This is in addition to limited publicity about the genebank and her operations as well as the poor linkages between GeRRI and her potential clientele. In a bid to the improve utilization of gene bank material in Nigeria, their National Centre for Genetic Resources and Biotechnology (NACGRAB) recommended vibrant branding campaign and public awareness in order to sensitize the stakeholders on germplasm utilization, networking with different users in order to have focused exploration/collection activities based on shared needs and collaborative evaluation in order to reduce cost (Olajire et al., 2015).

Germplasm acquisition/assembly

In terms of acquisition of early generation seeds, the GeRRI team collected about 2090 samples of various crops from both KALRO centres and universities. The three most collected crops (mungbean, quinoa and rice) accounted for over 80% of the samples acquired (Figure 9). Unfortunately, quinoa and rice are not part of KCSAP value chain crops. Food crops accounted for over 60 % of the accessions acquired. This observation is in agreement with the responses received from KALRO centres and universities where majority of researchers indicated they work on food crops (Figure 5 and 6). All wheat accessions collected were released cultivars (Figure 10). The situation was opposite for quinoa and mungbean where all accessions were not released cultivars. For maize, mung bean and rice, less than 2 % accessions of each crop were released cultivars. The GeRRI team collected more seeds samples from KALRO centres than the universities. This could be due to the fact the KALRO' Director General (DG) had written an introductory letter to institute and centre directors at the organization explaining what the GeRRI team intended to do and, requesting for cooperation. Consequently, KALRO researchers felt obliged to cooperate according to the directions by the DG. The situation was different for universities since the GeRRI Institute Director had to write letters to respective heads of schools/ faculties/departments of various universities seeking cooperation. Since the letters did not come from the universities management, the researchers/lecturers never felt obliged to cooperate. In addition, the core business of KALRO is research and there is a rich pool of researchers; for the universities, their core business is teaching while research is secondary.

In some instances, the seeds were not ready either because they were not mature, not processed or not sorted and packaged. Consequently, GeRRI staff were advised to collect these seeds once they are ready. It was not possible to collect planting materials of clonal crops because GeRRI's field genebanks were not yet ready. Once the field genebanks are well established, planting materials of clonal crops will be collected and conserved.

After the seeds were collected from all the institutions, they were registered in passport data sheets. Samples with low viability and/or few seeds were taken to the field for bulking and regeneration. Information about seed viability was given to the GeRRI team by the researchers who gave out the

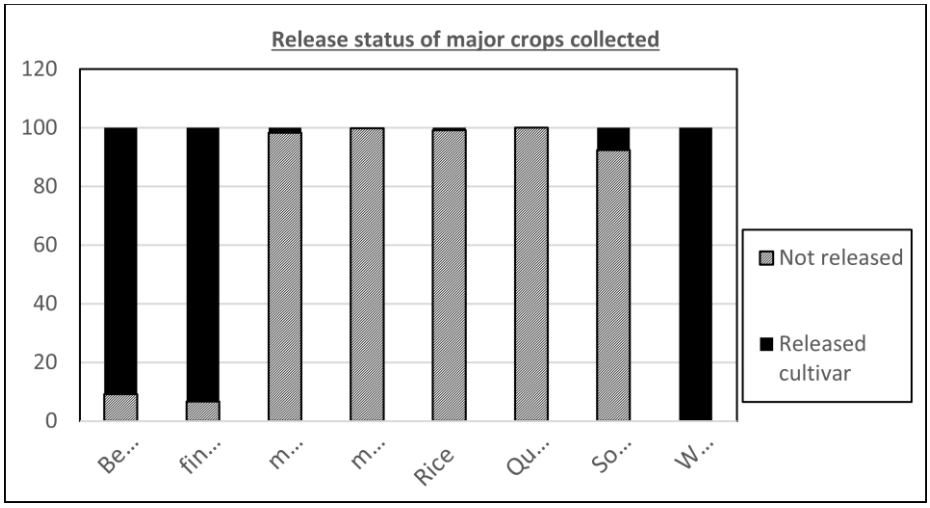

Figure 10. Percent release status of various major crops' accessions collected.

seeds. The seeds not bulked/regenerated were put in net-cloth drying bags, and dried to equilibrium moisture content under controlled conditions of 20^0C and 15 % relative humidity. Once dry, they were hermetically sealed in aluminium foils, given GeRRI accession numbers and conserved in the cold room at -20^0C.

Materials and methods

For a start, GeRRI team made telephone calls to heads of faculties/schools/departments that teach agricultural courses at various local public universities in Kenya to enquire about the availability of early generation seeds. In addition, individual lecturers who are known to be involved in plant breeding activities were contacted. However, the responses were quite discouraging. Consequently, it was decided that actual visits be made to these universities to enlighten the researchers/lecturers on availability of conservation facilities at GeRRI and to develop terms of engagement concerning depositing of seeds for safe custody. Before the actual visits were undertaken, a letter was sent to these heads to inform them of the impending visit and to secure the availability of their staff. During the visits, the GeRRI team were given seeds that were ready for conservation after reaching an agreement with the researchers; where seeds were not ready, the GeRRI team was advised to collect later. Thereafter, KALRO centres were visited. There was no need for coaxing KALRO researchers a lot. This is because KALRO's Director General had written an introductory letter to institute and centre directors at the organization explaining what the GeRRI team intended to do and, requesting for cooperation. Consequently, GeRRI team only went to KALRO centres to collect seeds. Because there are many institutions spread across the country, two teams were dispatched from GeRRI. One team visited the institutions located in the Central, Eastern and Coastal regions of Kenya (Team 1) while the other team (Team 2) covered institutions located in the former Rift Valley, Western and Nyanza provinces. During the visits to both KALRO centres and universities, a short questionnaire (Annex 1) was administered by the GeRRI team to the host staff in order to gauge the researchers' awareness of the existence and functions of GeRRI. In addition, extensive discussions were held to explore areas of possible collaboration. The GeRRI team took their time to assure the researchers, especially the sceptical breeders that their germplasm would be safe and secure at GeRRI facilities. The GeRRI team explained that the material transfer agreement (MTA) which GeRRI signs with institutions depositing their germplasm was water-tight and the deposited seeds cannot be used or distributed to anyone else without the express authority of the depositor. The visits to public universities were carried out between 25th April 2022 and 16th May 2022 while KALRO centres were visited between 9th and 25th June 2022.

Conclusion

Few local plant researchers from both KALRO and universities have ever requested seeds from GeRRI. Those who have deposited seeds into this facility were even less. To increase her visibility and enhance utilization of conserved germplasm, GeRRI was challenged to advertise themselves seriously through various platforms such as field days and website so that other stakeholders can know the germplasm collection they have, what they do and the services they offer. This could increase the confidence of plant scientists in working with GeRRI in seed deposits and requests. Most local researchers keep their orthodox seeds in stores in paper bags/gunny bags/plastic bottles at room temperature; this leads to rapid seed degeneration and increases the need for frequent regeneration. Seed regeneration is an expensive undertaking and most researchers are cash strapped. Consequently, most KALRO researchers called on GeRRI to regularly collect early generation seeds from breeders and keeping them safely at GeRRI's conservation facilities.

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