A scientist explaining some of the wild crop species at Entebbe Botanical Garden and Gene Bank. Photo Credit: Lominda Afedraru

Plant extinction: Sustainable conservation mechanism for posterity

By Lominda Afedraru

THE world we live in is ever-changing, growing and facing new challenges daily, including threats to the plants that sustain our existence as a result of climate change.

Scientists say 20 percent of plant species face extinction, including wild plants closely related to our crops. This is a result of climate change challenges, which cause pests and diseases as well as crop failures due to prolonged drought and erratic rains.

Most food the world population consumes comes from about three crop species namely wheat, rice and maize.

That's a very limited and narrow diet, considering the vast numbers of plant species available to provide food to people or diversity to crop breeding programmes.

As such, there is a deliberate effort by agricultural scientists at the Plant Genetic Resources Centre (PGRC) in Entebbe, Uganda, to collect plant species across the country, which are preserved for scientific use and regeneration in case of extinction.

Therefore, the talk by the public that indigenous plants in Uganda are not protected from climate change challenges is not true. Once you step into the botanical garden, you may think the plants are there to provide fresh air for a tourist attraction, which is not the case.

Background

The Plant Genetic Resources Centre is an institution under the National Agricultural Research Laboratories (NARL) of the National Agricultural Research Organisation (NARO).

It comprises the historical *Entebbe Botanic* Gardens and the Uganda National Gene Bank, located 34km north of Kampala and 5km from Entebbe International airport.

The gardens were established by the British Protectorate in 1890 to conduct agricultural research on plants with commercial interest for the industrial revolution in Europe as well as conserve crop resources that can be kept for future generations.

Long before agricultural research institutes such as Makerere University College of Agriculture and Environmental Sciences and the NARL Kawanda, among others, were established, Botanical Gardens in Entebbe was in place to help in research.

The facility was solely established for the examination and development of agricultural resources in Uganda, which is now used to address climate change effects among other aspects.

PanAfrican Agriculture had the chance of interacting with scientists at the centre who gave details about the agricultural conservation at the botanical gardens including the gene bank.

What constitutes the botanical gardens and gene bank?
According to Dr Catherine Kiwanuka, a senior officer at the PGRC, the gardens contain semi-domesticated plants, wild relatives of crops such as rice, sorghum, coffee, millet, tomatoes, and beans as well as exotic plants such as rubber trees.

Other tree species are mvule, mahogany, eucalyptus and ornamentals such as cedars, Mediterranean cypress, cannonball tree, coconut, Indian lilac, Borassus eaethiopum and oil palm, among others.

The gardens also have wild plants for food and medicine, grasses and legume forage for livestock.

In total there are more than 500 plant species, which are conserved in the gardens and the gene bank in form of seeds for breeding purposes to address challenges of pests and diseases arising from the effects of climate change.

Conservation strategies
Dr Kiwanuka noted that her team uses two methods of conserving the plants, one includes ex-situ, meaning the plants are collected from the wild and planted in selected protected farms owned by farmer associations or individual growers in various locations across the country.

The other method is in situ, which involves conserving seeds mainly in the gene bank, which was established in 2004 where seeds are kept in coolers and plant collection from across the country is conserved at the protected botanical gardens.

Dr Kiwanuka said Uganda has more than 603 plant species but only 11.15 percent is conserved, hence the need for more funding for the centres conserving activities.

Ms Joyce Adokorach, a research officer at the centre, says the botanical garden and the gene bank require about USh75 billion (USD 20,353.37) to run the activities of the centre for the next five years, including setting up a modern computerised centre.

The team obtains less than one percent of the money and in most cases, they are running short-lived projects on donor-funded activities.

Land use at the botanical garden
At the botanical garden, the land is divided into sections that include the rubber tree corridor where some of the exotic plants from other countries are preserved at the request of those countries' agricultural sectors. This is to meet their needs in case the tree gets extinct as a result of climate change.

There is the medicinal plant corridor, which includes plants such as *Wambugia Ugandesis, Peppermint, Henna, Neem, Cinnamon, Lavender, Marigold* and *Solanum aculeastrum* shrub.

Guava plant, one of the wild species used by scientists to extract genes to boost resistance against pest, diseases and draught. Photo Credit: Lominda Afedraru

Others are *Bidens pilosa, Helichrysum odoratissimum, Vernonia amygdalina, Hoslundia opposita, Ocimum gratissimum, Cymbopogon citratus, Cymbopogon nardus, Teclea nobilis, Zanthoxylum chalybeum* and *Lantana trifolia*, which are mostly used traditionally in the management of oral diseases.

The other section is for fruits, which include mangoes of various species, guava, pawpaw, oranges and lemons, pineapple, jackfruit, star fruit, avocado and mustaferi (Graviola), among others.

The last section composes traditionally introduced plants, which include four varieties of coffee namely Arabica, Robusta, Liberica and Excelsa. Liberica is mainly grown in Zirobwe in the Luwero district. Liberica is high yielding compared to the rest of the varieties. The vast majority associate Uganda with Arabica and Robusta varieties.

Other plants are banana varieties including wild relatives, wild rice varieties, cocoa, cassava and sweet potatoes.

Scientists contend that most of these plants have their wild relatives, and some of them are planted in the garden. In most cases, scientists use the wild species to extract genes, which are used to boost resistance against pests, diseases and drought in specific crops during breeding.

The seed bank

The gene bank manager, Ms Eva Zaake, says the garden and gene bank has conserved seeds of most crops consumed in Uganda.

These include various varieties of beans, sim sim, millet, sorghum, groundnuts, Bambara nut, which is mainly grown in the West Nile region, rice, maize barley, soybean, lentil, common pea, sunflower and green gram.

The team also preserves seeds of forage crops used as animal feed such as ***Chloris, brachiaria, Cenchrus, panicum*** and ***the legumes Clitoria ternatea, desmodium*** and ***cenrosema.***

Processing seed for preservation

Gordon Nsamba a laboratory technician at the gene bank, explains that once the scientists sample seeds of the various crops of interest for preservation, the first step is to test their viability using soil mixed with water in a bowl.

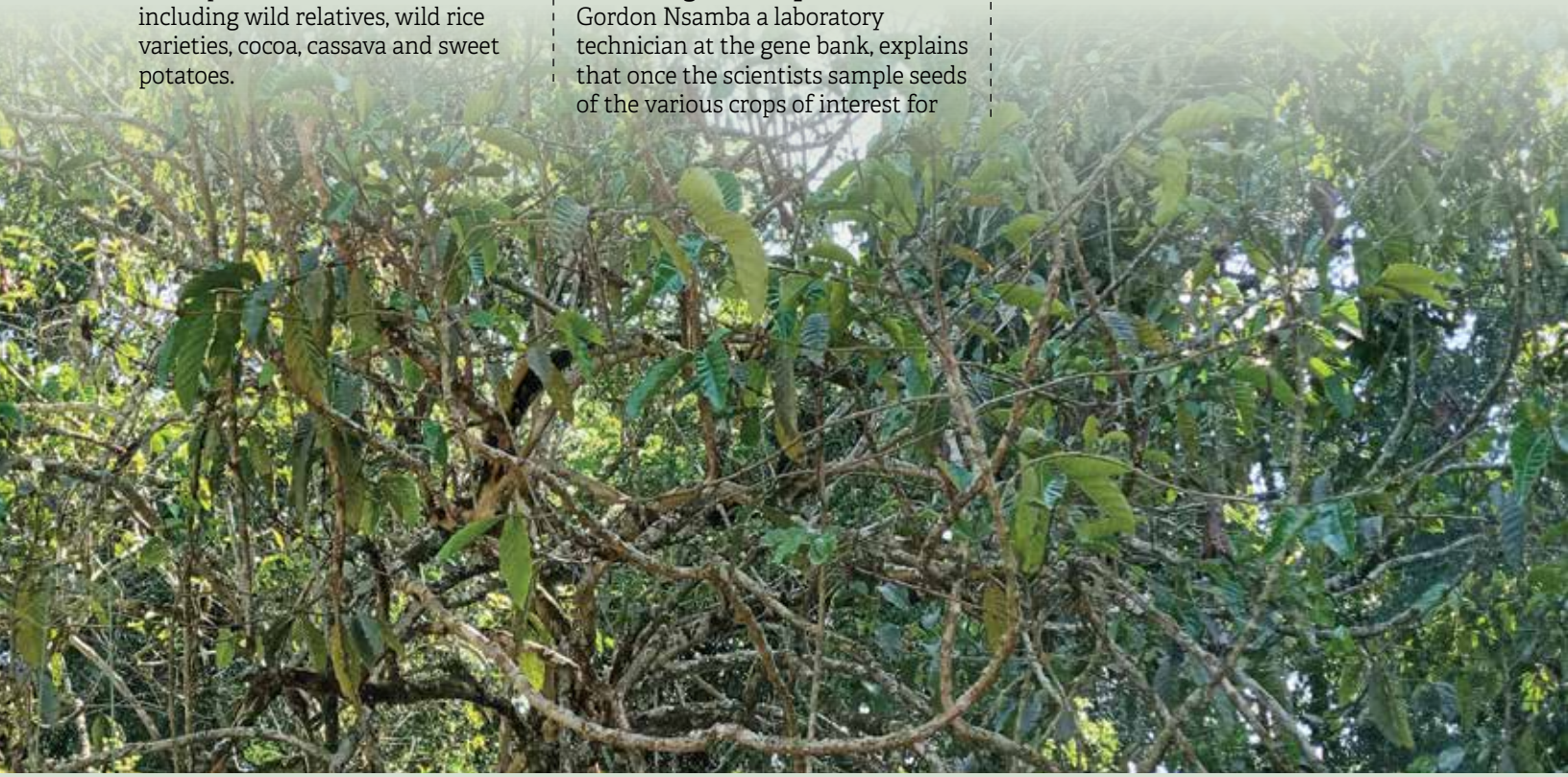
The viable seed is then multiplied by allowing it to grow and selection is done after harvesting and drying.

The moisture rate is tested using a moisture meter. Its germination rate is tested again with samples of seeds in the germination chamber.

After this process, the seed is waxed and kept either in glass boxes or in paper boxes, which are also waxed to avoid moisture penetration. The seeds are refrigerated and can last more than 50 years.

Dr Kiwanuka contends that there is need to intensify the process of setting up regional gene banks and botanical gardens to increase the rate of plant conservation.

The team has established community seed banks in most regions across the country, which farmer groups manage.



Liberica coffee. agricultural scientists at the Plant Genetic Resources Centre (PGRC) in Entebbe, Uganda, collect plant species across the country, which are preserved for scientific use and regeneration in case of extinction. Photo Credit: Lominda Afedraru