**RUFORUM Working Document Series (ISSN 1607-9345) No. 14 (2) : 679- 685. Available from *http://repository.ruforum.org***

Research Aplication Summary

# Cassava characterization and diverse use, the mirror for cassava landraces on-farm conservation in Uganda. An opportunity to genetic conservation and food security for rural communities

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## Abstract

Conservation of cassava (*Manihot esculentum*) genetic resources is crucial given their critical role in Agricultural production. Cassava landraces have over the years been conserved *in situ* directly or indirectly. However, farmer traditional knowledge conservation practices have not been fully documented in order to fully support the breeding community. The aim of this study therefore, was to evaluate farmer traditional conservation and management practices of cassava landraces in the Lake Albert Agro-ecological zone in Hoima and Bullisa districts, Uganda in particular Kigorobya and Kihungya sub-counties. The sample comprised 110 farmers as respondents for the survey and questionnaires administered for the period March – June 2016.(15) Key informants' interviews with 15 respondents and two focus group discussions were conducted. Results indicate that, farmers use above ground characters such as petiole color (21%), leaf color (20%) and branching habit (20%) and below ground cassava characters such as root taste (20%), root constriction (20%) and texture of root epidermis (20%) to select and distinguish between varieties. A total of 16 cassava varieties were reported to be grown by farmers and among these Nyakakwa (31%), Kazimwenge (30%), Nyalanda (10%) and Welobediyo (10%) were the most dominant. Stem multiplication by planting immediately after harvesting (62%), planting every season (18%) volunteer seedlings (2%), cutting back of stem and on-farm cassava retention (12%) were identified as traditional conservation practices of cassava varieties in Lake Albert Agro-ecological zone in Uganda. On farm conservation efforts of cassava landraces should be promoted through creation of awareness of criteria for characterization among smallholder farmers in order to inform genetic improvement.

Key words: Cassava landraces, *Manihot esculentum,* smallholder farmers, traditional knowledge

## Résumé

La conservation des ressources génétiques du manioc (Manihot esculenta) est cruciale compte tenu de leur rôle essentiel dans la production agricole. Les variétés locales de manioc ont été conservées in situ, directement ou indirectement au cours des années. Cependant, les connaissances traditionnelles sur les pratiques de conservation des agriculteurs n'ont

pas été entièrement documentées pour pleinement soutenir la communauté de sélection variétale. L'objectif de cette étude était donc d'évaluer les pratiques traditionnelles de conservation et de gestion des variétés locales de manioc dans la zone agro-écologique du lac Albert dans les districts de Hoima et Bullisa en Ouganda, en particulier les sous-comtés de Kigorobya et Kihungya. L'échantillon était composé de 110 agriculteurs et les questionnaires ont été administrés pendant la période de mars à juin 2016. Quinze entretiens avec des informateurs clés et deux focus groupes ont été effectués. Les résultats indiquent que, les agriculteurs utilisent des caractères au-dessus du sol de la plante de manioc tels que la couleur du pétiole (21%), la couleur des feuilles (20%) et l'aptitude à la ramification (20%) et les caractères en dessous du sol tels que le goût des tubercules (20%), la constriction racinaire (20% ) et la texture de l'épiderme de la racine (20%) pour sélectionner et distinguer les variétés entre elles. Au total, 16 variétés de manioc sont cultivées par les agriculteurs et parmi celles-ci Nyakakwa (31%), Kazimwenge (30%), Nyalanda (10%) et Welobediyo (10%) étaient les plus dominantes. La multiplication de tige par plantation immédiate après récolte (62%), plantation au début de chaque saison (18%), plantules volontaires (2%), boutures et rétention du manioc au champ (12%) ont été identifiées comme des pratiques traditionnelles de conservation de variétés de manioc dans la zone agro-écologique du lac Albert en Ouganda. Des efforts de conservation sur pieds des cultivars de manioc doivent être promus à travers la sensibilisation des petits agriculteurs sur les critères de caractérisation afin de rendre disponible des informations pour l'amélioration génétique.

Mots clés: Cultivars de manioc, Manihot esculenta, petits agriculteurs, connaissances traditionnelles

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## Background

Cassava (*Manihot esculentum*) is widely cultivated in many countries and is the staple diet of more than 500 million people (Oliveira, 2015). A total of 1,200 local cassava varieties have been identified in Africa and with a higher genetic diversity for the sweet than for the bitter varieties. Local cassava varieties yield between 5-10 t/ha (Etonihu *et al.,* 2011) and some are very susceptible to pests and diseases. Traditional farming systems and the associated indigenous knowledge are under threat with growing pressure resulting from the distribution of improved varieties and genetic erosion of crop diversity (Munyi *et al.,* 2008).

Understanding the traditional conservation practices of cassava varieties is vital (Adrikoet *et al.,* 2012) since these landraces are more acceptable to farmers for various reasons, such as below ground storability, taste and compatibility with other crops in diverse cropping systems. The research will contribute to the Agro ecology partnership frame work and efforts to improve the collection, selection and characterization of cassava landraces, as a collaborated objective among farmers, research institutions in Uganda and East Africa specifically to conserve cassava landraces in the region.

**Literature summary**

Research has shown that cassava has in recent years transformed from a famine reserve commodity and rural staple to a cash crop in Africa (Akinpelu *et al.,* 2011). Through traditional use such as fermentation, it can also be used for alcohol production, processed into biogas. Recent findings from field studies in the forest/savannah (Adjei-Nsiah *et al.,* 2012) transitional agro-ecological zone indicates that when cassava is integrated in the cropping system as a form of rotation, cassava contributes significantly to maintenance of soil fertility, and thus large scale production of cassava for industrial use can contribute to poverty reduction in an environmentally responsive way.

Morphological parameters such as levels of branching (whorls), angle of branching, height at branching and plant height varies significantly among cultivars (Raji *et al.,* 2007) and angle of branching comparable to each other. This is significant as it helps in suppressing the weed flora, by forming a dense canopy. Because of this, farmers have been very careful in selecting landraces that make weeding less intense under the cultivars. Leaf number correlates positively with root yield (Lahai *et al.,* 2013) and the high tuber yields or common with improved cultivars. Farmers with traditional knowledge have linked cassava leaves as an important determinant of tuber yield while in other areas this is the opposite. Cassava landraces continue branching until harvest. Due to this branching habit, landacres produce more folige compared to other cultivars.

**Study area**

The study was conducted during the period of March –June 2016 in the Lake Albert Agro-Ecological Zone located in mid - Western districts of Uganda. The study adopted purposive sampling in identifying two districts and two sub-counties with a high population of local cassava varieties. This was done in Kigorobya, Kihungya sub-counties in Hoima and Bullisa districts, respectively. Six (6) villages were randomly selected from the two districts for the study Data collection was conducted in March 2016. First, a focal point contact was made to the agro-ecological zone during which 15 key informants identified with the help of technical staff. Two focus group discussions were conducted. Other data were obtained from secondary sources, key informant responses, and personal observations. Sampling involved stopping at regular predetermined distances of approximately 50 to 100 m between farmers' fields/households along major motorable roads traversing each sampling village. A sample of 110 cassava farmers were randomly selected for the survey and questionnaires administered. Data were entered in SPSS version 16, analyzed using descriptive statistics and proportions. Proportions were computed based on the relative number of mentioned respective selection criteria by respondents as a fraction of total responses in a particular category (above and below ground). Factor analysis was conducted, and variables with communalities above 0.4 were considered for analysis. For each test variable: proportions, standard deviation, and standard error of proportion were obtained.

**Results and research application**

Farmers use both above ground and below ground cassava characters to select and distinguish between varieties. On the basis of above ground characters farmers base their selection criteria on petiole color, color of apical leaves, branching habits, leaf color as well as color of stem exterior. Petiole color (21%), leaf color (20%) and branching habit (20%) are the most prominently utilized criteria for variety characterization and selection by farmers (Table1). The below ground characters most used by famers for characterization and selection include; root taste (20%), root constriction (20%) and texture of root epidermis (20%) (Table 1).

Table1. Farmer criteria for cassava landraces characterization and selection

| Type of character | Farmer selection criteria | Proportion | Std. Error of propn |
|---|---|---|---|
| Above Ground | Petiole colors | 21% | 0.0186 |
| | Color of apical leaves | 19% | 0.0178 |
| | Branching habit | 20% | 0.0184 |
| | Leaf color | 20% | 0.0184 |
| | Color of stem exterior | 20% | 0.0182 |
| Below Ground | Root constriction | 20% | 0.0179 |
| | Number of commercial roots | 20% | 0.0179 |
| | Taste | 20% | 0.0181 |
| | Root shape | 19% | 0.0177 |
| | Texture of root epidermis | 20% | 0.018 |

Farmers' knowledge of characterization and selection as described above has been very critical in cassava varieties evaluation (Oluwole, 2007). In this study, sixteen cassava varieties were identified based on farmers' knowledge (Fig. 1). Among these, Nyakakwa (31%), Kazimwenge (30%), Nyalanda (10%) and Welobediyo (10%) were the most dominant in cassava growing communities of the two districts.

Traditional cassava conservation also draws a lot from farmers' knowledge. This has been documented as an indirect approach for improvement and conservation of plant traits such as yield in breeding programs (Khumaida *et al.,* 2015). In this study, farmers' knowledge was documented in (Table 2) below. Based on frequency of mention, stem multiplication /planting immediately (62%), planting every season (18%) and on-farm cassava retention (12%) were identified as traditional conservation practices of cassava varieties.

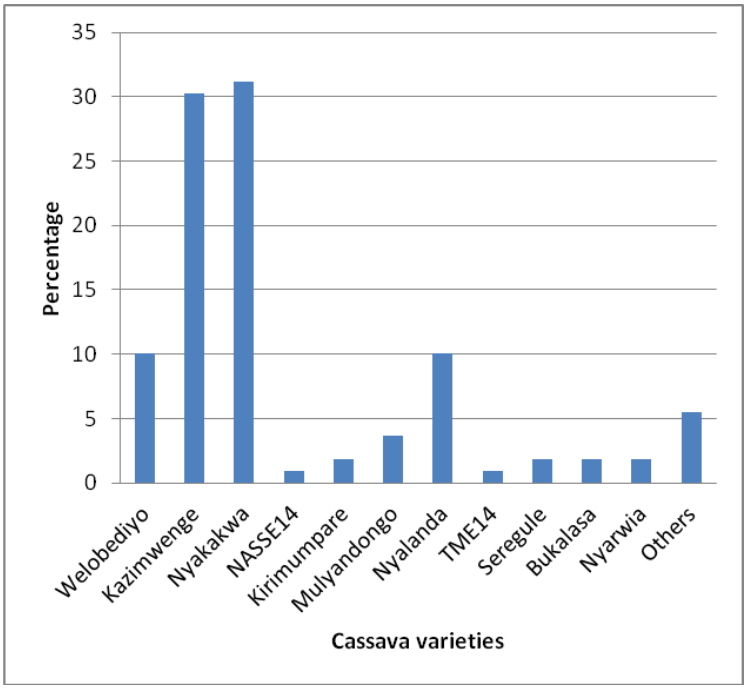


Figure 1. Popularity of cassava varieties in the Lake Albert Agro ecological zone based on total respondents (N=110).

Table 2. Cassava conservation practices

| Practices | Frequency | percentage |
|---|---|---|
| Stem multiplication/planting immediately | 66 | 62 |
| Volunteer seedlings | 2 | 2 |
| On farm retention | 13 | 12 |
| Planting every season | 19 | 18 |
| Cutting back stems | 6 | 6 |
| Total | 110 | 100 |

In addition farmers were found to implement good conservation practices through good cassava management practices for example intercropping (61%), boundary planting (6.7%), and shifting cultivation (11.4%). Famers' knowledge has also been useful in identifying cassava common diseases (CMD) (Elias *et al.,* 2000, Sseruwagi *et al.,* 2006). Traditional practices, especially intercropping and incorporation of volunteer seedlings, would promote the cultivated stocks.

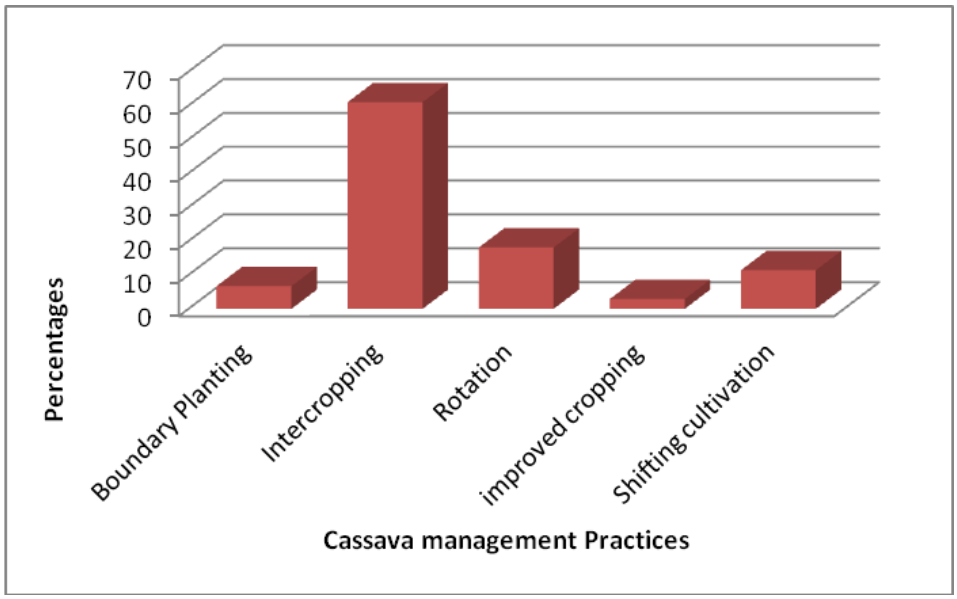


Figure 2. Cassava management practices

In conclusion, farmers' knowledge is invaluable in identification, management and conservation of cassava varieties. Participatory approaches involving farmers would therefore, contribute greatly to conservation efforts of local cassava varieties. Farmers' knowledge can also inform genetic improvement of cassava and enhance strategies for food security.

**Acknowledgements**

This project is funded by The Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) under the Competitive Grants System (No. RU 2015 GRG114). Makerere University for training students and providing the necessary facilities. This paper is the project's project contribution to the 2016 Fifth RUFORUM Biennial Conference and African Higher Education Week 2016.

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