

## Research Article

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# Specialised Sweetpotato Vine Multiplication in Lake Zone, Tanzania: What “Sticks” and What Changes?

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**Abstract:** In Lake Zone, Tanzania, farmers were trained to multiply and distribute quality sweetpotato planting material. The objectives of this study were to assess changes in skills and practices among the trained farmers as vine multiplication became a specialized task. Nine months after the project ended, all 88 decentralized vine multipliers (DVMs) operating as groups (72%) or individuals (28%) were visited and qualitative data on their current multiplication practices collected through a questionnaire, checklists and observations. Results showed that 69% of DVMs were still multiplying vines, but less than half were using the seed production technologies promoted by the project. 34% used rapid multiplication beds; 61% used conventional plant spacing on ridges for roots and vines and 5% used both. As the vine multiplication cycle became a specialised activity, the multiplication and root production cycles were separated. Vines were treated differently in terms of site selection, length of cutting and spacing, depending on whether the objective of their use was for high root or high vine production. Capacity building of specialised vine multipliers and scaling-up seed interventions should consider the implications of skilling and task segregation in a broader context based on society’s choice of technologies and agrarian change.

**Keywords:** sweetpotato vine multipliers, training, specialisation, skilling, adaptation, scaling-up, seed enterprise

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## 1 Introduction

There is heated debate among seed system practitioners on the best way to support smallholder farmers with timely access to adequate quantities of quality seed as planting material<sup>1</sup> (David 2004; Coomes et al. 2015; McGuire and Sterling 2016). The perishable and bulky characteristics of the planting material in vegetatively-propagated crops, which predisposes decentralised and local seed production approaches, further support the aforementioned discussion (McEwan et al. 2015). The formal seed sector plays a limited role in the seed provisioning choices for smallholder farmers, who predominantly select vine cuttings for planting material from their own fields or from informal sources such as local markets, kin and neighbours (Kapinga et al. 1995; Namanda et al. 2011; Adam 2014). Sourcing vines as such can be advantageous because they are easily accessible and may not involve monetary transactions. However, the health of such vines can be unknown. Additionally, sourcing vines can also come with moral and social obligations. Therefore, strengthening and leveraging informal seed networks for the dissemination of modern varieties and healthy seeds, and understanding how to scale seed interventions appropriately to benefit more farmers with quality seeds are important questions (Coomes et al. 2015; McGuire and Sterling 2016). Non-governmental organisations have used one approach which supports and links farmer-based seed enterprises to sources of improved seeds and then leverages farmer networks for wider dissemination (Jeremiah et al. 2007; Kimenyi and McEwan 2014). However, there is limited understanding about what happens when different

<sup>1</sup> In sub-Saharan Africa sweet potatoes are vegetatively propagated by taking an apical cutting of 25-30 cm with three to five nodes from a vine for use as planting material. True botanical seed is obtained only from crossing in breeding programmes. In this paper, seed (in the generic sense) and planting material are used interchangeably to mean vine cuttings selected and used as planting material.

types of farmers are trained to operate as individuals or farmer group vine multipliers, and how skilling takes place as multipliers adapt new knowledge and skills into their existing seed system practices (Stone, 2007). The objectives of this study were: to identify any changes in seed sourcing and site selection for vine multiplication; to determine if and how the trained multipliers (DVMs) used and adapted seed production technologies promoted by the project; and to assess the current status of sweetpotato vine multiplication and the reasons for abandoning or continuing it.

## 2 Methods

This section first provides a brief overview of the project intervention approach implemented between January 2011 to June 2012 (18 months) (Catholic Relief Services 2012). It then describes the method used for the study which was implemented mid-February to mid-March 2013, nine months after the intervention finished.

The intervention aimed at increasing quality planting material availability at the start of the rainy season to promote early planting, take full advantage of unpredictable rainfall, and to increase root yields. NGO staff identified and trained individual farmers and farmer groups to become decentralised vine multipliers (DVMs). The selection criteria for DVMs included: previous experience with sweetpotato production, access to adequate land, reliable water for irrigation, ease of access for customers and be reputable in the community. Initially, the project targeted individual farmers as potential multipliers. However, after the first season of research, it was found that such approach favoured male farmers. Therefore, implementing partners also identified existing farmer groups with a high proportion of women to become DVMs. Training and follow up visits were conducted by the NGO field supervisors and the following technologies were included: vine conservation, pest and disease identification and management, agronomic management practices and rapid multiplication techniques (RMT). RMT consists of using separate multiplication beds, shorter three node cuttings, close spacing (10 cm x 20 cm) and more intensive agronomic management. The technology is used to boost the production of vines (for subsequent use as planting material) rather than roots. Multipliers learned how to keep varieties in separate beds, to use labels showing varietal characteristics, and to avoid mechanical mixing of different varieties during harvest.

Five varieties (Polista, Ukerewe, Kabode, Ejumula, Jewel) were multiplied and distributed by the DVMs to

farmers. Pathogen tested tissue culture materials were multiplied *in vitro* by a private sector tissue culture laboratory in Nairobi, Kenya. The tissue culture plantlets were transported to Maruku Agricultural Research Institute in Bukoba, Kagera Region, hardened, then transferred and multiplied in open fields. After two to three months, cuttings were taken and distributed to research stations, NGO partners and DVMs for further open field multiplication. Subsequent cuttings were distributed as planting material to farmers by a subsidised voucher system. The DVMs and farmers received information about the benefits of quality planting material through demonstration plots and communication materials. During the intervention period, the DVMs produced and distributed approximately 10 million cuttings<sup>2</sup> of quality planting material of new and existing sweetpotato varieties to 85,000 farmers, 76% of which were women (Catholic Relief Services 2012).

During this study, nine months after the intervention ended, all 88 decentralized vine multipliers (DVMs), who had been trained and supported by the project, were visited. This included 14 (16%) who withdrew from the project or did not disseminate vines (Laizer and Walsh 2012). Mixed methods involving both quantitative and qualitative data collection instruments were used to investigate the sweetpotato seed system as a social and technical configuration, including the processes and interactions within it (Jansen and Vellema 2011). Data were collected through a structured questionnaire with closed-ended questions to determine individual and group DVM characteristics, current and past season seed production practices and reasons for abandoning or continuing multiplication. Data were disaggregated by gender and whether multiplication was undertaken as a group or on individual basis. Descriptive analysis was conducted using SPSS (v 17) and Microsoft Excel. Qualitative data were collected through observations and semi-structured interviews (i.e. checklists with open-ended questions) with a sub-group of 12 DVMs during the project's implementation, from August 2010 to June 2012, and during the study in March 2013. Combining methods and collecting data at different points both during and after the intervention provided an opportunity to check for internal consistency of the experiences reported by the DVMs, and develop an understanding of the reasons behind certain decisions and practices. Excerpts from

<sup>2</sup> At a planting rate of 33,300 cuttings per hectare this can cover an initial 300 ha. Each farmer received between 100-200 cuttings enough to plant approximately 35 m<sup>2</sup>. Farmers take further cuttings from the initial planting to extend their area under production.

these interviews are presented to provide insights into the processes which accompanied changes in practices (Yin 2009; Silverman 2010).

### 3 Results

The survey found that 72% and 28% of the 88 DVMs worked as a group or as individual multipliers, respectively. Twenty-eight per cent of the individual DVMs were females and 72% were males. The membership of the group DVMs ranged from 10 to 30 members. Sixty-eight per cent of group DVMs had 50% or more female memberships (including 19% which had equal male and female farmer memberships). Forty-three per cent of the group DVMs were already established before the project started. Eighteen per cent of the DVMs had been multiplying and selling sweetpotato vines before the project intervention started. A higher proportion of the individual DVMs (28%) had previous experience in sweetpotato vine multiplication compared to the group DVMs (14%).

#### 3.1 Changes in seed sourcing and selecting sites for multiplication

Findings from the semi-structured interviews at the start of the project intervention can be corroborated by earlier studies (Kapinga et al. 1995; Namanda et al. 2011; Adam 2014) that in the existing sweetpotato seed systems, the predominant sources of planting material are from friends, neighbours and relatives. Over the period of the intervention, DVMs became more aware and used different sources of vines for further multiplication. Balizukwa DVM's chairwoman explained: *“previously, friends and relatives (aunts) gave vines freely to each other in the village. Now as part of the DVM group it is good to know who we are getting the planting material from e.g. if it is from an NGO or research the vines have been “purified”. If it is from government it would be pure as it does not want to distort”* (Field interviews: Ilemela District 12/8/2011). There were no examples of DVMs (post-project) actively seeking new varieties or replacement materials from the research system; instead, they were still reliant on NGOs or projects as intermediaries. Multipliers explained that they now obtain new varieties from each other or from multipliers supported by other projects. They were aware that NGOs had multiplication plots from where they used to obtain replacement material. However, they were unsure if the plots were still in operation after the project

ended (Field interviews: Sengerema 1/12/1012; 30/11/2012; Musoma Rural 28/11/2012).

Farmer knowledge about the new varieties was uneven. A female member of the Tunu DVM group stated that *“Returning clients ask for “Kabode”, “Jewel” and “Ejumula”. “Polista” is not asked for as much as “Kabode”. New customers have the information already – “Marando Bora” has spread a lot so a lot of customers come with the name of the variety which they want “Kabode”.* (Field interview Geita District, 30/11/2012). In contrast, an individual DVM in Nyamapande said that: *“the customers do not know enough about the different varieties or which is best so they just take what I recommend or what I have”.* (Field interview, Sengerema District, 1/12/2012).

In the existing system, farmers with access to lakesides or swampy areas used these lands to conserve planting material during the dry season from June to October. Then, depending on seasonal conditions – as the water levels by the lake become too high - farmers either shifted their vines to upland fields for rain-fed production or chose a small, less waterlogging prone area in the lowlands for root production in November. The roots were harvested in February-March, and the vines transferred to upland fields for the main rainy season production. During the project period, a key criterion for selection of potential DVMs was reliable access to water for irrigation over the dry season (June to September). Some group DVMs rented suitable land based on a guaranteed income from the exchange of vouchers or the sale of vines. At the end of the project, many of the DVMs struggled to continue multiplication because the owners repossessed the land and, subsequently, were unable to access or rent another suitable site. However, an example from the Tunu Group DVM illustrated how some DVMs were able to actively manage site selection and multiplication practices in response to seasonal conditions. The group members had observed variety-specific site requirements (e.g. the Kabode variety did not tolerate water logging) and adjusted to identify suitable land using both group based and individual strategies. A female member explained the group's strategy: *“The group is splitting the farm as they need to rent land in different places. We pay Tsh 50,000/- for 2 acres. We are moving Jewel and Ejumula to upland fields as we think there will be less disease and they will do better. There is also a lot of water at the moment in the current site and the vines get destroyed. In the dry season the site also has problems because as it dries up the soils become too hard to work – and we have to irrigate. So we want a place that is average and have found it; but we will still keep the current site. All members have taken material to their own farms for producing roots and vines and then*

*the group will select material to bring back to the current site as the dry season progresses, and the water goes down. In the upland area we are planting for roots as a group - we have already planted – Jewel, Ejumula and Kabode.* (Source: Field interviews: Female group member, 25-30 years, Tunu Group, Nungwe, Geita District, Tanzania 30/11/12.)

### 3.2 Changes in seed production practices

The questionnaire-based survey found that 34% of the 61 DVMs who were still actively involved in vine multiplication used close spacing in beds (i.e. RMT), 61% used conventional plant spacing on ridges for roots and vines, and 5% used both multiplication beds and ridges. RMT requires higher management and irrigation frequency; thus, greater time and labour inputs. Table 1 shows that fewer male-dominated groups (22%) were practicing close-spacing multiplication compared to female-dominated groups (50%). However, the reverse was true for individual multipliers, where fewer women practiced RMT (27%) compared to men (40%).

Eighty-nine per cent of all DVMs used fertiliser (urea and NPK) throughout the project, but this percentage had dropped to 26% at the time of the survey. The reasons for discontinued use may be related to cost, availability, or market uncertainty for vines. A higher proportion of the female-dominated groups were using fertiliser during the project and continued after the project compared to the male-dominated group DVMs. Overall, 97% of all DVMs irrigated their multiplication plots (95% of group DVMs and 100% of individual DVMs). The main sources

of water were wells, springs, lake, river or dam water. Female-dominated DVM groups used more key resources required for vine multiplication (e.g. irrigation, fertilisers, RMT) compared to both male-dominated group DVMs and individual female DVMs. Female-dominated DVM groups have also managed to continue their multiplication activities, perhaps due to extension visits. However, there was no difference in the number of extension visits received by different types of DVMs. Women multipliers were more confident of their skills as part of a group when asked to rate themselves as such.

### 3.3 Intention and practice to continue multiplication

Nine months after the intervention ended, the results of the survey indicated that around 70% of all DVMs (88% and 62% of the individual and group DVMs, respectively) were multiplying in that season (February/March 2013). However, visits to the multiplication beds revealed a more nuanced picture in which 48% of DVMs were classified as currently multiplying vines for sale and 52% had stopped. Among those who had stopped multiplying, 16% intended to re-start and others were continuing to multiply planting material for personal use. Some, while currently planting on ridges, intended to shift to vine conservation in seed beds in the dry season (from May) and then expand multiplication again in August for sale in October. Those DVMs that were continuing multiplication stated that there was a high demand for vines of the improved varieties both within their group, but also from the wider

**Table 1:** Multiplication status and use of multiplication technology nine months after intervention closed (March 2013)

Type of DVM	Currently multiplying for next season		Multiplication technology used					
			Close spacing in beds		Conventional spacing for roots & vines		Using both	
	No.	%	No.	%	No.	%	No.	%
All DVMs	61	69	21	34	37	61	3	5
All individual DVMs	22	88	8	36	13	59	1	5
Male individual DVMs	15	83	6	40	8	53	1	7
Female individual DVM	7	100	2	27	5	71	0	0
All group DVMs*	39	62	13	33	24	62	2	5
Female Majority Group DVMs	18	58	9	50	7	23	2	11
Male Majority Group DVMs)	9	60	2	22	7	88	0	0
50:50 Group DVMs	9	75	1	11	8	89	0	0

\*NB: 5 of the group DVMs do not have disaggregated data

Source: DVM questionnaire, March 2013

community. At the time of this study, at the start of the “long” rains, farmers were using conventional spacing on ridges to produce roots and vines. As the dry season started (in May), farmers explained that they would shift to conservation practices, such as maintaining small seed beds in areas closer to water sources. The most common reason stated by 41% of the 52% of DVMs who had abandoned vine multiplication was that there was “no market” for vines. Some DVMs were located in areas where community mores discouraged vine sales; others said that there was no market without the subsidised voucher price, or that farmers would not buy from the DVMs because they had multiplied sufficient “marando bora” varieties. The second reason mentioned by 17% of the DVMs was related to group dynamics, e.g. disagreements over sharing the work; but in some of these cases, individual members continued to produce and conserve new variety materials. The third reason mentioned by 15% of the DVMs was related to wildlife encroachment by hippos and wild pigs, and environmental and site conditions, such as flooding or lack of water. The other reasons were related to family illness or death, or to issues during project implementation around voucher reimbursement or the DVM withdraws as vine multiplication was not profitable for them. (Source: Lusheshanija field notes, March 2013).

## 4 Discussion

Much of the literature on adoption of agricultural technologies focuses on improved crop varieties and defines adoption as a discrete event in terms of harvested area or percentage of farmers using modern varieties (Rogers 2003; Walker *et al.* 2014). However, if we approach this discussion from a seed systems perspective, we also need a better understanding of how the decentralised seed producer plays a role in the dissemination of improved planting material and as a key link between the source of new varieties and the farmer. This is a multi-faceted process and cannot be restricted to the seed and multiplication technologies alone (Glover *et al.* 2016). It requires on-going navigation and negotiation to adjust specialised vine multiplication techniques depending on the agro-ecological community and market situation. Farmers were trained during this project to become DVMs and to become specialised in vine multiplication. The decision of DVMs to continue multiplication or not once the project finished was related to several factors: the market for vines and roots, the particular season (i.e. short or long rains) and personal circumstances. DVMs adapted some of the new practices into their existing system by

choosing the appropriate time to use rapid multiplication techniques in seed beds in the off-season rather than all year round, and by shifting to vine conservation and root production between different ecologies. In the existing seed systems, vine and root production are integrated. However, as the vine multiplication cycle changed to a specialised activity, there were some indications that tasks were becoming segregated as vines were being treated differently in terms of site selection, length of cutting, plant spacing and agronomic management. This segregation depended on whether vines were to be used for high vine or high root production. Multipliers with access to lowland used rapid multiplication techniques in the dry season. Other multipliers spread their risk by maintaining conventional practices for both vine and root production. This highlights potential trade-offs between seed quality and diversified income sources from roots and vines.

Assessing the conditions under which changes in sweetpotato seed system practices took place less than a year after the end of the intervention may have been premature. Further research is needed to confirm which types of multipliers have continued to use the knowledge and skills promoted by the project. However, the results from this study indicated that a higher proportion of the female group DVMs continued to use new knowledge and skills for the management of specific diseases, rapid multiplication, and fertiliser use compared to other categories of DVMs. Women multipliers in groups reported being more confident of their multiplication skills compared to those working as individuals. This suggests that the social capital among women is strengthened when they work as a group as it facilitates their access to resources for their DVM activities (e.g. suitable land with access to water), during and after the project. Furthermore, group work increases the skills and self-confidence of stakeholders in using new seed production technologies. These groups had a broader range of social-economic objectives compared to the individual multipliers, whose focus was on income generation from the sale of planting material and roots. This has implications in the selection of multipliers depending on the purpose and context of a seed intervention, and whether to work with groups or individual multipliers to ensure that vine multiplication can be technically, financially and socially sustainable. As we design interventions aimed at building the capacity of specialised vine multipliers and scaling-up seed systems, we should consider the implications of skilling and segregation of tasks in the broader social context in choosing technologies and agrarian change (Stone 2007). New skills may become embedded if they

are adapted into existing technical practices and social systems. Specialisation may only be viable when there is a consistent market for vines and roots. In the short term, social factors may play a more critical role in the sustainability of vine multiplication.

## 5 Conclusions

The results show that nine months after the project intervention ended, some trained multipliers continued to use new skills related to bed preparation, plant spacing, use of fertiliser and irrigation. Follow up studies are required to confirm whether skilling in vine multiplication leads to a segregation of tasks and separation of vine and root production and to understand the implications of specialisation in different market and agro-ecological contexts.

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## References

- David, S., Farmer seed enterprises: A sustainable approach to seed delivery? *Agriculture and Human Values*, 2004, 21(4): 387-397
- Coomes, O. T., McGuire, S. J., Garine, E., Caillon, S., McKey, D., Demeulenaere, E., et al., Farmer seed networks make a limited contribution to agriculture? Four common misconceptions. *Food Policy*, 2015, 56: 41-50
- McGuire, S. and Sperling, L., Seed systems smallholder farmers use. *Food Security*, 2016, 8(1): 179-195
- McEwan, M., Almekinders, C., Abidin, P. E., Andrade, M., Carey, T., Gibson, R., Naico, A., Namanda, S., Schulz, S., Can small still be beautiful? Moving local sweetpotato seed systems to scale in sub-Saharan Africa. In: Low, J.W. et al. (eds.) *Potato and Sweetpotato in Africa Transforming the Value Chains for Food and Nutrition Security*. CABI, UK, 2015
- Kapinga, R. E., Ewell, P. T., Jeremiah, S.C., Kileo, R., Sweetpotato in Tanzanian Farming and Food Systems: implications for research. International Potato Center, Nairobi, Kenya. Ministry of Agriculture, Tanzania, 1995
- Namanda, S., Gibson, R.W., Sindi, K., Sweetpotato Seed Systems in Uganda, Tanzania, and Rwanda. *Journal of Sustainable Agriculture*, 2011, 35(8): 870-884
- Adam, R. I., Gender and the Dynamics of Production and Distribution of Sweetpotato Planting Materials Among Smallholder Farmers in the Lake Victoria Zone Region, Tanzania. PhD thesis, College of Agricultural Sciences, The Pennsylvania State University, USA, 2014
- Jeremiah, S. C., Kulembeka, H. P., Kanju, E., Chirimi, B., Amour, R., The role of community based organisations, NGOs and farmers in technology transfer. Proceedings of the XIIIth Triennial Symposium of the International Society for Tropical Root Crops, Arusha, Tanzania, 2007
- Kimenye, L., and McEwan, M., eds. *Scaling up, Dissemination and Adoption of Agricultural Technologies using Innovation Platforms – Lessons from Eastern and Central Africa*. ASARECA, Uganda, 2014
- Stone, G.D., Agricultural Deskillling and the Spread of Genetically Modified Cotton in Warangal. *Current Anthropology*, 2007, 48, (1), 67-103
- Catholic Relief Services. SASHA Marando Bora Final Technical Report., Dar es Salaam, Tanzania, 2012
- Laizer, L. and Walsh S., Seed system lessons learned from Marando Bora in Lake Zone, Tanzania. Paper presented at 16th Triennial Symposium of the International Society for Tropical Root Crops, 23-28 September 2012, Abeokuta, Nigeria.
- Jansen, K., and Vellema, S., What is technography? *NJAS - Wageningen Journal of Life Sciences*, 2011, 57(3–4): 169-177
- Yin, R. K., *Case Study Research: Design and Methods*. California, USA, Sage Publications Inc., 2009
- Silverman, D., *Doing Qualitative Research a Practical Handbook*. London, Sage Publications Ltd., 2010
- Rogers, E.M., *Diffusion of Innovations*, Free Press, New York, 2003
- Walker, T., Alene, A., Ndjeunga, J., Labarta, R., Yigezu, Y., Diagne, A., Andrade, R., Muthoni Andriatsitohaina, R., De Groote, H., Mausch, K., Yirga, C., Simtowe, F., Katungi, E., Jogo, W., Jaleta, M. & Pandey, S., Measuring the Effectiveness of Crop Improvement Research in Sub-Saharan Africa from the Perspectives of Varietal Output, Adoption, and Change: 20 Crops, 30 Countries, and 1150 Cultivars in Farmers' Fields. Report of the Standing Panel on Impact Assessment (SPIA), CGIAR Independent Science and Partnership Council (ISPC) Secretariat: Rome, Italy, 2014 (Accessed 6/11/2016 [http://impact.cgiar.org/files/pdf/ISPC\\_DIIVA\\_synthesis\\_report\\_FINAL.pdf](http://impact.cgiar.org/files/pdf/ISPC_DIIVA_synthesis_report_FINAL.pdf))
- Glover, D., Sumberg, J., Andersson, J. A., The Adoption Problem; or Why We Still Understand so Little about Technological Change in African Agriculture. *Outlook on Agriculture*, 2016, 45(1): 3-6