Research Article

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Decentralised sweetpotato (*Ipomoea batatas*) vine multiplication in Lake Zone, Tanzania: Five years later

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Abstract: Farmer-based seed multiplication is widely promoted by development practitioners, but there is limited understanding of the individual or collective motivations of farmers to engage or disengage in specialised seed production. The objective of this study is to understand the factors influencing the continuity of sweetpotato vine multiplication enterprises in the Lake Zone of Tanzania, five years after support from a project ended. A total of 81 out of 88 trained group or individual decentralised vine multipliers (DVMs) were traced to assess their vine multiplication activities. Qualitative and quantitative data were collected through telephone and field interviews. Our data showed that 40% of the 81 DVMs had sold vines in the year prior to the study and 20% had maintained the improved varieties for their own use. Some group members had continued vine sales as individuals. The DVMs' reasons for abandoning vine multiplication included climatic and water access issues, market factors and group dynamics. The DVMs did not engage in high volumes of commercial sales. Socio-economic norms and values underpin the transactions of sweetpotato vines. These norms may undermine the emergence of commercially viable enterprises yet seem navigable for a substantial number of the DVMs. Group DVMs seem less commercially successful than individuals.

Keywords: seed production models, social norms, commercialization

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1 Introduction

1.1 Rationale for local seed production models

There have been wide-ranging efforts in sub-Saharan Africa (SSA) to address the constraint of timely access by smallholder farmers to adequate quantities of quality seed for the planting season (McEwan et al. 2015). Public sector models face the challenges of capacity constraints, limited reach and linkages through the seed value chain (Minot et al. 2007; Rajendran et al. 2017), which have led to a general disillusionment with the ability of public and parastatal seed enterprises to meet farmer's seed requirements. This has led to calls for greater private seed sector involvement (Douglas 1980; Tripp 2002; Minot et al. 2007), and over the last decades, there has been considerable growth in commercial interest and, investment in, seed production of crops such as maize and vegetables (Van Mele and Bentley 2011; Rutsaert and Donovan 2020a; Rutsaert and Donovan 2020b) However, for other open-pollinated or vegetatively propagated crops such as legumes, roots,

and tubers, commercial interest in seed production has lagged, due in part to perceptions about unreliable and risky markets (Jones et al. 2001; Bishaw et al. 2009; McEwan et al. 2015). These crops play a key role in maintaining the food security of producers as well as rural and urban consumers. Yet, investments in the breeding of improved varieties will not be leveraged without the appropriate seed production and delivery channels. Community-based approaches have been advocated as promising ways to engage farmers as private entrepreneurs who could provide key connections between the formal and informal sectors (FAO 2015).

There are other considerations that contribute to the rationale for a local or decentralised approach to the dissemination of quality planting materials for vegetatively propagated root and tuber crops. Their bulky and perishable nature makes local seed production approaches more attractive as these reduce transportation distances and costs (Andrade-Piedra et al. 2016; McEwan 2016). In addition, multiplication is relatively technically simple for trained farmer-multipliers, because genetic characteristics are maintained through clonal reproduction. But, for the same reasons, the potential for commercially viable seed production and supply models is questioned. If farmers can easily multiply their own planting material, then there must be specific reasons for farmers to acquire planting material from an external source (Almekinders et al. 2019): even more so when farmers are expected to purchase the planting material for cash, rather than relying on farmer-to-farmer exchange in which non-cash relations prevail (Ngabo 2015; Tadesse et al. 2017).

1.2 Previous initiatives and studies

In the 1990s and 2000s, there were a range of efforts to broaden the delivery systems for the seeds of food security crops. These included seed fairs, voucher systems, and mass multiplication and dissemination as a part of post-disaster responses (Catholic Relief Services et al. 2002). Centralised seed production models have been criticised for high levels of wastage of perishable planting material and challenges with ensuring the varieties or timing preferred by farmers (Remington et al. 2002). Alternative community, local or decentralised seed production models working with existing multipliers, entrepreneurial groups or individuals have been promoted by non-governmental organisations (NGOs) in collaboration with national and international agricultural research organisations (David 2004; Setimela et al. 2004; Witcombe et al. 2010; Van Mele and Bentley 2011; FAO and ICRISAT 2015; De Roo and Gildemacher 2016). There are also strong advocates for a greater integration of the informal and formal seed systems with a balance of public and private sector investment (Louwaars and de Boef 2012). These approaches depend on a better understanding of farmer-to-farmer seed networks and the institutions, social relations and cultural norms that may influence seed movement (McGuire 2008; Coomes et al. 2015), and explorations as to how these might manifest as examples of the social embeddedness of economic activities (Friberg and Götz 2015; Siméant 2015).

1.3 Group approaches

Another consideration with decentralised approaches is whether seed production activities are best organised on an individual or group basis. Organised farmer groups are considered to have two important advantages: it is easier to support a group than separate individuals and groups are likely to have a better market position because members can pool their resources, production and sales efforts (Shiferaw et al. 2011; De Roo and Gildemacher 2016). Organised women or youth groups are in particular considered to benefit from the latter effects (Mudege et al. 2018). While the group approach is being widely advocated and apparently piloted, it also raises concerns. On the one hand, collectiveness may be a hindrance in maintaining seed quality (Tadesse et al. 2020), while on the other hand, diverse interests within a group can be a threat to the collective action (Shiferaw et al. 2011). There is also a debate about the sustainability of seed production models after project support ends (Van Mele and Bentley 2011; Rachkara et al. 2017). The role of the moral economy also plays a role in the discussion on their economic sustainability. As mentioned earlier, in many situations non-cash exchanges of seed prevail. McGuire (2008) pointed out how these exchanges can be considered a part of a system of norms and values but that these non-cash exchange mechanisms do not necessarily mean easy access (gifts can, e.g., be tied to reciprocal obligations). Siméant (2015) also argued that the social embeddedness of economic exchanges should not be detached from patron–client relationships among different socio-economic groups. In sum, there are arguments that favour the decentralised vine multiplier (DVM) model and arguments that question it. There is, however, hardly any information on the way individuals and group multipliers sustain their enterprises over time (Almekinders et al. 2019).

The current study arose from a unique opportunity to follow up an intervention using a decentralised vine

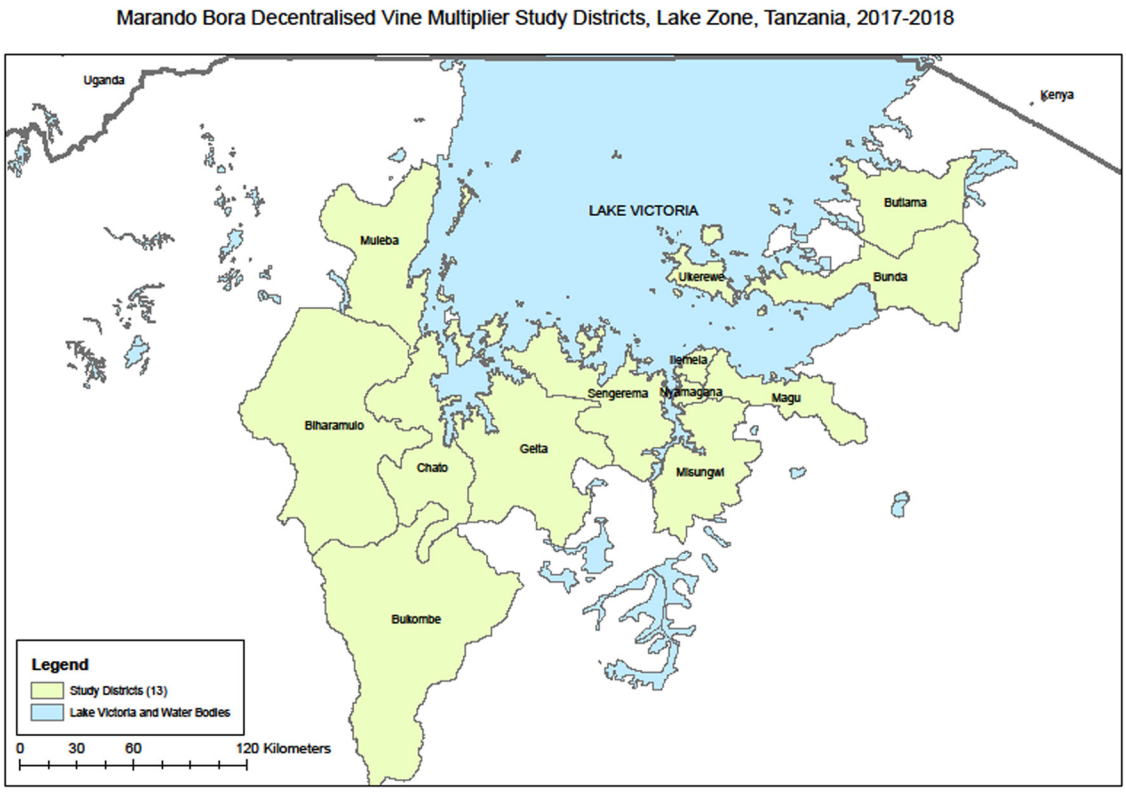

Figure 1: Marando Bora DVM Study Districts in Lake Zone, Tanzania (Source: Global Administrative Areas (www.gadm.org), OpenStreetMap and WFP GeoNode Road Network, and openAFRICA (www.africaopendata.org) Districts).

multiplication model five years after a project had finished, in order to determine how (and whether) the vine multipliers had continued their activities. An earlier study was conducted nine months after the intervention ended and found that 69% of the DVMs were still multiplying the improved varieties (McEwan et al. 2017). This paper explores the drivers contributing to the continuity of seed enterprises producing and disseminating improved sweetpotato varieties in the Lake Zone of Tanzania and discusses some of the implications of the DVM model for the dissemination of new varieties.

2 Materials and methods

The study was conducted in all 13 original implementation districts[1] for the DVM model of the Marando Bora project in the Mwanza, Geita, Kagera, and Mara Regions of Lake Zone, Tanzania (Figure 1).

Data were collected using a combination of qualitative and quantitative methods to capture the complex social–technical interactions in seed systems (Nuijten 2011). We conducted a review of previous studies, secondary data on agricultural production, and hosted a stakeholder workshop with the research, extension and NGO partners who were involved in implementing the Marando Bora project. The 88 DVMs that were trained by the project were traced and interviewed by telephone to establish the current status of their vine multiplication activities. There were two types of DVMs based on how they had operated their vine enterprise during the project. Individual DVMs, who operate their vine multiplication on an individual basis, were classified as individual male or individual female DVMs, depending on who was registered, although many male individual DVMs were operated on a household basis. Group DVMs are those that operate as a group, sharing labour tasks and distributing vines among the group members, with some groups also selling surplus vine production. Group DVMs were classified as having a majority of male members, a majority of female members, equal male and female members or for which the gender composition of the group was not known (as project records were not complete). Consent and confidentiality were confirmed before

1 Muleba, Biharamulo, Chato, Bukombe, Geita, Sengerema, Ilemela, Nyamagana, Misungwi, Ukerewe, Bunda and Butiama districts

Table 1: DVMs interviewed by type of interview, Lake Zone, Tanzania, October 2017–December 2018

Type of DVM	Traced DVMs	Telephone interview only	Field interviews
Majority female member group	30	16	14
Majority male member group	17	6	11
Equal male and female members	8	5	3
Sex not known	4	4	0
All group DVMs*	**59**	**31**	**28**
Individual female	7	0	7
Individual male	15	4	11
All individual DVMs	**22**	**4**	**18**
All DVMs	**81**	**35**	**46**

Source: telephone and field interviews, October 2017–December 2018.
*Sex composition of groups followed the classification at the end of the project.

the start of interviews (see Annex 1 for telephone-based interview questions). Eighty-one (of the 88) DVMs were traced. Seven DVMs (four groups, two individual male and one individual female DVM) could not be traced either by cell phone number or through local contacts or declined to be interviewed. Using the information obtained through the telephone interview, we categorised the DVMs according to their current sweetpotato vine multiplication status. Those who:
(a) continued to sell the improved Marando Bora varieties (defined by having sold vines in the year preceding the survey),
(b) continued to multiply the Marando Bora varieties for their own use or
(c) stopped sweetpotato production, multiplication of the Marando Bora varieties or the DVM group had broken up.

Key informant interviews were conducted with agricultural officers in 11 of the 13 study districts, where the field interviews were conducted. Field-based semi-structured interviews were conducted with 46 DVMs (Table 1). These DVMs were purposively selected to capture a range of contexts based on the following criteria:
(a) their current status (continuing to sell vines or not), group or individual (male or female) organisation of the vine multiplication exercise,
(b) agro-ecology: upland (rainfed) or lowland (with access to water for irrigation) and
(c) proximity or distance to important markets for sweetpotato roots.

The field-based interviews were conducted in three rounds to coincide with the main periods when vines sales take place. These were October–December 2017, March 2018 and October–December 2018. The interviews included questions on household characteristics, livelihood activities and the status of the sweetpotato vine multiplication enterprise. DVMs were asked about the types of customers, purchasing patterns and contact details to be able to trace and interview vine buyers (see Annex 2). The majority of DVMs did not keep records and could not provide contact details for their customers. Therefore, additional data on farmer and customer vine acquisition characteristics were collected through spot interviews with customers (separate paper in preparation). Two workshops were held in Chato and Bunda districts in May 2018. A total of 32 (53% female) DVMs participated in focus group discussions to obtain a deeper understanding on changes in the gender division of labour and a constrained analysis for sweetpotato seed production (separate paper in preparation). The semi-structured interview data from DVMs were entered and coded in SPSS and analysed according to the number and/or frequencies of answers to identify differences and trends. For some questions, the numerical presentations were analysed using descriptive statistics (sums, percentages). The qualitative data were used to support and explain differences and trends in the quantitative data.

3 Results

3.1 Background: sweetpotato production in the Lake Zone and the Marando Bora project

Sweetpotato is an important staple crop in the Lake Zone (the region around the Lake Victoria basin), where, a third of Tanzania's population, approximately 15 million inhabitants live (United Republic of Tanzania 2018). In this zone, this crop is the fourth most important (after maize, cassava and rice) (United Republic of Tanzania 2012) crops that have all been affected by unreliable rainfall, and pest and

disease outbreaks. With flexible planting dates, a short growing season, relative drought tolerance and the nutritional benefits of the micro-nutrient-rich orange-fleshed varieties, there has been growing interest by government, NGOs and farmers in expanding the area under sweetpotato production. This is reflected in national and regional sweetpotato production figures with Tanzania overtaking Nigeria and Uganda (Food and Agricultural Organization 2017; United Republic of Tanzania 2017). While sweetpotato has always been regarded as a food security crop (Kapinga et al. 1995), it is also increasingly a cash crop. This is evidenced by the emergence of roadside markets (acting as aggregation points for sweetpotato roots) along the major routes linking Dodoma and Shinyanga to Dar es Salaam, and Tarime with the Kenyan border.

In Tanzania as in most of SSA, the sweetpotato is predominantly propagated by vine cuttings, taken from unharvested roots left in the ground that have sprouted after the rains. The disadvantage of this method is that farmers need to wait six to eight weeks after the start of the rains to obtain planting material. Moreover, as the roots remain in the ground from one season to the next, there can be an accumulation of diseases and pests, such as sweetpotato virus diseases and sweetpotato weevil (*Cylas puncticollis* and *Cylas brunneus*). Farmers with access to lowlands, with residual moisture, plant a small vine and or root plot during the short rains (September/October to mid-December) to bulk up planting material for upland production in the long rains (late February to mid-May) (Namanda et al. 2011). Earlier research had identified timely supply of planting material and distribution of improved varieties as major constraints to sweetpotato productivity and argued that in SSA, only virus-free planting material could yield rates of return of between 56 and 84%, depending on the short-term rate of adoption and the longer term adoption ceiling (Kapinga et al. 1995; Gibson et al. 2009).

Building on this information Sweetpotato Action for Security and Health in Africa (SASHA) designed the Marando Bora (Better Vines) project for the large-scale dissemination of planting material, which targeted 1,50,000 farmers and was implemented in four regions of Lake Zone, Tanzania. The project area has a bimodal rainfall pattern, with sweetpotato vine conservation over the dry season and multiplication practices determined by proximity and access to water sources and lowlands. Farmer-to-farmer exchange of planting materials was the dominant system in the area, although in some circumstances, where there is a prolonged dry period, there was evidence of a commercial vine market (Sindi et al. 2011). The practice of selling vines was common in areas with a long dry season (2.5 months or more) and areas closer to established markets for roots. However, in many areas, there were strong "traditions" and social norms around sharing planting material, which is made easier by the vegetatively propagated nature of the crop. The peak period of demand for vines is during September–October just at the start of the short rains (Namanda et al. 2011).

From October 2009 to September 2012, the project developed and tested the models for distributing sweetpotato varieties at a large scale and in a cost-effective way with the aim of increasing the availability of quality planting material at the start of the rainy season in order to promote early planting, take full advantage of unpredictable rainfall, and increase root yields. Two dissemination models were operationalised in different intervention areas: a partially subsidised voucher-based distribution system through 88 DVMs established over the duration of the intervention and a fully subsidised mass dissemination model. NGO staff identified and trained the farmers and to become specialised multipliers with 72% of the DVMs operating as groups and 28% as individuals (Catholic Relief Services 2012; McEwan et al. 2017). The selection criteria for the support from the project included: previous experience with sweetpotato production, access to adequate land, reliable water for irrigation, ease of access for customers and a good reputation in the community. Some individuals ($n = 16$) had already been engaged in selling vines of local sweetpotato varieties. Initially, the project targeted individual farmers. However, after the first season of research, it was found that male farmers predominantly qualified, leading to concerns that women were being marginalised by the project's activities (Badstue and Adam 2011). This led the project's instigators to seek existing farmer groups with a high proportion of women as partners. Some of these groups were savings, credit and loans groups engaged in different crop and enterprise activities. Group membership ranged from 5 to 25, with an average of 20 members. Five improved varieties were distributed: two were white-/cream-fleshed landraces which were cleaned up to remove the viruses (Polista and Ukerewe), and three were orange-fleshed varieties (Jewel, Ejumula and Kabode). Of the total 1,11,912 beneficiaries reached by the project, 85,029 (76%) received planting material through the DVM model. Of those, 74% were women in households with children under five years of age.

3.2 Current status of commercial vine multiplication activities and experiences

Of the original 59 group DVMs that were traced, 42 were no longer functioning as a group selling planting material of varieties distributed through the Marando Bora project

Table 2: Current status of Marando Bora decentralised sweetpotato vine multipliers, Lake Zone, Tanzania, 2016–2017

DVM type	Original DVMs (2012)	No. DVMs traced (2017–2018)	No. group disbanded/ stopped vine production/ stopped MB varieties	No. Multiplying Marando Bora varieties for own use	No. Continuing to multiply Marando Bora varieties for sale (*)
Male majority	15	17	12	1	4 (+7)
Female majority	31	30	21	5	4 (+5)
Equal male/female	12	8	6	0	2 (+2)
Sex composition not known	5	4	3	1	0
All group DVMs	**63**	**59**	**42**	**7**	**10 (+14)**
Male individuals	18	15	3	7	5
Female individuals	7	7	1	3	3
All individual DVMs	**25**	**22**	**4**	**10**	**8**
All DVMs	**88**	**81**	**46**	**17**	**18 (+14)**

*The number between brackets refers to additional individual DVMs that were identified, i.e. former group members who were now selling sweetpotato planting material as individuals.
Source: Telephone and field interviews, 2017–2018.

(Table 2). However, seven groups were still multiplying these varieties for their own use and 10 other groups were still selling as a group. In addition, we identified 14 individuals who had been members of a DVM group that stopped but had now started to sell vines as an individual business (Table 2). So, in some cases where a group had disbanded or stopped sweetpotato vine multiplication activities, we found that individual members of the group had started their own vine multiplication activities.

Of the 22 individual DVMs that were traced, eight (36%) were still selling vines of Marando Bora varieties. Of the other 14 individual DVMs, four had stopped sweetpotato vine production but 10 still multiplied for their own use. A higher percentage of female individual DVMs (43%) had continued their commercial multiplication of Marando Bora varieties compared to male DVMs (36%). The majority of those continuing to sell sweetpotato vines were above 45 years of age and had completed primary school education. There were also some individual male DVMs who were in the 36–45-year age group. The men were married and during the project had participated together with their wives. The female DVMs were either married or widowed.

The results indicate that of the total of 81 DVMs traced (operating as a group or as individuals), 32[2] (40%) were still selling planting material of Marando Bora varieties in the year prior to the study (Table 2). Of those who were continuing to sell, approximately 30% had received support from other projects after Marando Bora closed. Another 21% had maintained the Marando Bora varieties for their own use but had not continued to actively engage in commercial vine sales. The remaining 39% of the DVMs had either stopped sweetpotato production, were no longer using improved varieties or the group that they had been a part of had broken up. Of the 16 DVMs that had sold vines prior to the commencement of the project, three could not be traced (as they were deceased or had moved), five had stopped, six were still selling, and two continued with Marando Bora varieties for their own use (data not presented).

As part of the field interviews, DVMs were also asked more generally about how their vine enterprise had fared since the project ended, and why they were continuing. In the past, sweetpotato production was the responsibility of women because of its role in assuring food security in the home and women's role in crop production, sourcing varieties and planting material. Interviews with DVMs and key informants indicated that attitudes and practices may be changing: sweetpotato is now considered a cash crop. DVMs related the increasing importance of sweetpotato to the effect of climatic variation on the production of other crops (e.g. rice), disease outbreaks in maize, cassava and banana, and marketing uncertainty (coffee). One male DVM noted: "*before sweetpotato was a woman's crop but of late men are involved in the crop – all activities because it is now a commercial crop*." This comment is supported by the information from key informant interviews with district officials and observations of the main transport routes where roadside markets are selling sweetpotato. In the focus group discussions, women mentioned how engagement in specialised vine multiplication,

2 This includes former group members who were now selling sweetpotato planting materials as individuals.

and the associated income – has led to increased respect for them in the household and community. This shows that different social norms and practices are emerging around sweetpotato. For example, managing access to appropriate land and water resources is in some of the cases jointly negotiated by wife and husband for the mutual benefit of the household.

3.3 Reasons for stopping or continuing commercial vine multiplication

Table 3 presents different types of DVMs' reasons for stopping commercial vine multiplication. The reasons for stopping selling sweetpotato vines varied between group DVMs and individual DVMs. Among the group DVMs, 33% struggled with finding water or coping with drought conditions. The Lake Zone experienced extended dry periods in 2015, and many DVMs recalled "losing their vines" in that year, i.e., that their planting material had completely desiccated. Specialised sweetpotato seed production requires access to water during the dry season, so that sufficient vines can be multiplied to be sold to farmers at planting time. Group-related issues were also mentioned, i.e. group disintegration or a new project providing support for a different group activity. Groups had broken up for different reasons: internal group dynamics, a change in leadership or "free loading," i.e. perceptions that some members were not putting in the proportionate effort, to the benefits they gained from being part of the group.

By contrast, individuals who had abandoned decentralised vine multiplication more often mentioned market-related factors, which accounted for 40% of their responses (Table 3). In these cases, the explanations provided mentioned that farmers in their area already had vines of the Marando Bora varieties or that it was not the tradition to sell vines. Pests, diseases and destruction by livestock or flooding were relatively important for both types of DVMs and accounted for an average of 11% of responses overall. Project-related reasons and the ending of the subsidised voucher system were mentioned by both types of DVMs.

3.4 Varieties: retention and loss

During project implementation, each DVM (group or individual) received two to five improved varieties for multiplication and distribution between 2010 and 2011. While the ideal had been to provide all varieties to each DVM, the actual allocation of varieties depended on the availability of material from the primary multiplication sites. The relative proportions of each variety supplied from the field multiplication at the Agricultural Research Station, Maruku, to Marando Bora were Ejumula: 49%; Polista and Ukerewe: 15%; Kabode: 11%; and Jewel: 7% (Catholic Relief Services 2012).

We wanted to understand which varieties DVMs were able to maintain, why and whether this had any bearing on their success as commercial seed producers, i.e., farmers went to DVMs to obtain new varieties. Table 4 shows that of the multipliers reporting, Polista was the most frequently retained variety (48%) followed by Kabode (34%), Ukerewe (23%), Ejumula (12%) and Jewel (11%). Polista was the only variety that DVMs in all 11 districts visited for the field

Table 3: Reasons for stopping selling sweetpotato vines for groups and individuals, Lake Zone, Tanzania, 2016–2017

Type/status	Group (*n*)	Individual (*n*)	Total (*N*)
All DVMs	59	22	81 (100%)
DVMs stopped selling	35	14	49 (60%)
Reasons for stopping (*)			
Drought or lack of water	14 (33%)	3 (15%)	17 (27%)
Group dynamics/disbanded	7 (16%)	1 (5%)	8 (13%)
Project related	7 (16%)	2 (10%)	9 (14%)
No market/varietal preference	6 (14%)	8 (40%)	14 (22%)
Pests, diseases, destruction by wildlife, flooding	5 (12%)	2 (10%)	7 (11%)
Other	3 (7%)	1(5%)	5 (8%)
No reason given	1 (2%)	3 (15%)	4 (6%)
Total responses*	43 (100%)	20 (100%)	63 (100%)

Source: Telephone and field interviews, 2017–2018.
* Multiple responses possible.

Table 4: Number and percentage of group and individual DVMs who retained planting material of Marando Bora distributed sweetpotato varieties, Lake Zone, Tanzania, 2016–2017

	Sweetpotato varieties				
	Jewel	**Polista**	**Ejumula**	**Ukerewe**	**Kabode**
No. of DVMs receiving	64	69	68	69	68
No. DVM groups retaining	3	9	1	4	5
No. individual DVMs retaining	4	24	7	12	18
No. (%) of all DVMs retaining	7 (11%)	33 (48%)	8 (12%)	16 (23%)	23 (34%)

Source: Telephone and field interviews, 2017–2018.

interviews persisted with. When asked why they retained Polista and Ukerewe, DVMs stated that these varieties were tolerant to diseases and drought, with Polista noted as being well-marketable (both vines and roots) because of the large roots and high dry matter content. Ejumula and Jewel were considered susceptible to sweetpotato virus diseases. However, some DVMs gave other reasons for retaining Ejumula, which related to nutrition for their families and sale of vines when there is the opportunity. One female DVM noted that she conserved Ejumula as it did well on her farm, and another noted that she did not have difficulty selling the variety in her community.

Reasons for losing or retaining a variety related to its susceptibility to drought and diseases and market preferences. More individual DVMs had retained one or more varieties compared to group DVMs. 2015 was frequently mentioned as the time when Marando Bora varieties were lost, with drought and diseases being the most common reasons mentioned. Other reasons for losing varieties included: group-related dynamics, floods, shifting to other activities, no market, the "vines got tired" (i.e. the DVMs' explanation of yield declines due to the accumulation of pathogens that contribute to seed degeneration) and the theft of vines.

If they lost a variety, some DVMs would find replacement material of the same variety within their network of other multipliers, neighbours and kin or by contacting research stations. Depending on the variety, between 9% and 21% of the DVMs who had received a variety replaced it. Of the 49 multipliers who were continued to multiply (for sale or own use), the majority were also multiplied other non-Marando Bora varieties, with male DVMs having the highest number of other varieties. These included local landraces and improved varieties distributed through subsequent projects. DVMs also noted that they and the community had gained experience over time about what the different varieties are best used for, so there is increasing differentiation among the varieties in terms of use, i.e. home consumption, marketing and to some extent processing. Kabode was noted as being suitable for traditional sweetpotato-processed products such as *mchembe* and Jewel, with lower dry matter, more suitable for using in *chapati*, and *mandazi*.

3.5 Customers and types of transactions

DVMs mentioned in the interviews that their main customers were farmers from the surrounding community (within 10 km). The customers of the second type were from institutions such as NGOs and government institutions. Individual male DVMs were the only ones to mention traders as customers and group DVMs were the only ones to mention "events" (e.g. agricultural shows) as a source of customers. There was a mixture of one-off and repeated customers. A few DVMs had had between 80 and 98 customers over the past two growing seasons (i.e. in one year); however, the majority of DVMs reported between five to ten customers over the last year, of which they could recall some details of the volumes and transactions.

Table 5 shows one example of the range of customer types for a female vine seller and the different types of transactions she engaged in. For example, church members who live at some distance were gifted vines (in small quantities) because there was a reciprocal arrangement for sharing vines. However, neighbours, both male and female, had paid in cash for a very small quantity, because she knew that they intended to use the vines for further multiplication and subsequent sale. With an institutional customer, such as the prison, the volume was large, and the transaction was in cash. From this example, first, we can see that the total number of transactions and volumes are small and that the different modes of exchange depended on the relationship between the seller and buyer and the motivations of each.

For groups, the predominant unit of sale was a "bundle" (head-load/bicycle load) that was not standardised but ranged in the equivalent of 100–300 × 30 cm cuttings, with a price range per cutting of 7–20 TSH (US

Table 5: Example of customers and associated transactions for one individual female vine seller, Lake Zone, Tanzania, 2017–2018

Type of customer	Relationship	Distance (time)	Varieties	Volume	Type of transaction	Reason for gifting
Individual (F)	Church member	1.5 h	Kabode, Carrot Dar	0.5 sack handful	Gift	They requested and they also share with me
Individual (F)	Church member	2.5 h	Kabode	1 sack	Gift	
Individual (F)	Neighbour, same group	5 min	Kabode	30 vines	100 TSH/cutting	Bought for further multiplication
Individual (M)	Neighbour	5 min	Kabode	20 vines	100 TSH/cutting	
Prison	No relationship	30 min	Kabode	3 sacks	7,000 TSH/sack	

NB the respondent was first interviewed as a customer of a DVM, but during the interview, she explained that she also sold vines and was part of a group (F: female, M: male).
Source: Field survey 2018.

$0.003–0.009). Individual DVMs more commonly used bags as the unit of sale, with approximately 1,200 × 30 cm cuttings/bag (depending on the variety). Unit price per 30-cm cutting ranged from 4 to 40 TSH (US$0.002-0.018). The pattern of requests for varieties depended on what was available, but Kabode was most frequently mentioned followed by Polista.

3.6 Gifting and the moral economy

Most of the DVMs who had sold vines in the last two seasons had also gifted vines. In addition, those who were categorised as having stopped selling vines still in many cases gave vines to family and/or friends. Of the DVMs we interviewed in the last round (n = 27), over the previous year, three had just sold vines and nine had only shared vines as a gift, while the majority (12) said their transactions were a mix of selling and gifting. Focus group discussions and interviews showed that strong social norms influence perceptions about sweetpotato, e.g. in relation to gender roles for production activities, the sharing of seed and, as a food, to who it can be served to. We further explored the practices and perceptions around giving and selling vines, to understand whether these held a manifestation of the concept of moral economy and thus how the moral economy might play a role in accessing seed. DVMs gave different motivations for selling or sharing. We identified examples of Siméant's "Moral Economy 3" (2015), i.e. the social embeddedness of economic exchanges and the economic implications of moral practices. The DVMs explained their motivations and reactions around the selling, gifting and stealing of vines. Two examples illustrate the DVMs' rationale for selling. A female member of a group DVM explained: "*It is the cost that is associated with improved varieties that makes someone sell improved varieties… people buy local varieties when there is scarcity, but it is not the tradition, otherwise people wait and pick from other peoples' farms*". In Bukombe District, where there is a steady market for roots, and DVMs sell both orange- and non-orange-fleshed varieties. an individual female DVM explained: "*many root producers don't have lowland to conserve vines. At the onset of rains, they come to buy*." In these examples, selling is motivated by the rationale of cost recovery given that specialised seed practices require more effort for roguing (removal of diseased plants or off-types) and irrigation and that access to key resources provides the comparative advantage to be able to sell vines. The impetus for gifting vines is a combination of empathy, altruism and building social capital, together with a dose of pragmatism. An individual female DVM noted: "*Sometimes you relate* [*to*] *the needs of other persons and put yourself on their shoes, but I also give sparingly – just a few vines and a lot more when I have leftovers after planting*." There was broad consensus in terms of the types of people DVMs would not sell to, i.e. the very poor who have no steady means of livelihood, elderly women, people with special needs or chronic illness and, in general, the DVMs would not sell if it was a few vines to neighbours or close relatives. Another individual female DVM explained: "*Even if you don't share, what will you do with the extra vines? Will you feed them to your cows?… Your vines can also dry up, where will you get new ones from?" "It affects my business but if they come borrowing, I will still give, I don't have much choice, it is better to give them away, than to have someone stealing them*." Others also regarded giving a few vines away free as promotional samples to potential customers. Therefore, gifting to maintain good community relations also had an element of marketing as well as reciprocity as a way of spreading risk, because the DVMs knew they may also need to ask for vines

in the future. We asked DVMs about one common proverb: "to steal seed is not a sin". With "stealing," an individual male DVM in Ukerewe Island differentiated between local and improved varieties: "*we don't sell vines to anyone. If someone says he has bought vines, people will be shocked and surprised*." But "*they don't cut my improved varieties because they know they belong to the project; they are afraid if they steal from the project they will be arrested*."

We also found that parallel pricing systems are emerging "*people know seed for sale is better quality than what they get for free. People are already accepting that*." There can be a price differentiation between local vines (TSH 1,000) and improved ones (TSH 5,000). Therefore, commercialisation and a business approach are still mediated by strong sentiments related to community obligations "justness." We asked the DVMs how they balanced their social obligations with the development of their business. Some set the number of families they will assist or the quantity they will gift in order to meet their social obligations; some set the amount that they want to sell and then the rest they are happy to gift; some only gifted vines from their root production field, not their vine multiplication plot, i.e., gifted vines may be older and of poorer quality. Some would gift but only in very small quantities.

4 Discussion and conclusions

Our follow-up study provides empirical evidence for an exploratory understanding of key themes related to the motivation of individuals and groups to continue in specialised seed production for sweetpotato. The survey traced 81 of the original 88 trained DVMs and found that a total of at least 32 groups and individuals (40%) were still active as DVMs in the 2016–2017 season (i.e. five years after the project ended) selling planting material of improved varieties. Other individuals who had been part of groups that had disintegrated may have continued selling vines on their own, but these were not exhaustively identified.

The results of the study also suggest that more individual DVMs (more than three-quarters) were able to keep their vine multiplication and commercialisation going compared to group DVMs (less than a third). Apart from the project and voucher subsidy ending, the reasons for groups and individuals stopping commercial vine multiplication differed. For DVMs operating as groups, extended dry periods and lack of water to irrigate the vine multiplication plots were major reasons to stop commercial vine multiplication. This may point to difficulties within groups to organise labour for irrigation, especially if there were competing demands for labour at the household level. The project had actively sought out existing farmer groups to take up decentralised vine multiplication, yet around 10% of the groups stopped this activity because the group had broken up, for a variety of reasons. Shiferaw et al. (2011) found that key factors for successful collective action included good governance and being a homogenous group of optimal size. In our case, our interviewees mentioned internal group dynamics, changes in leadership and "free-loading" as reasons for groups breaking up, thus underlining the importance of mechanisms to manage group tensions, when these are heightened through additional labour requirements for watering. For individual DVMs, market conditions and social norms were the key factors that influenced their decision to abandon commercial vine production. This may highlight that, as individuals, they were more concerned to see a financial return on their efforts, whereas for group DVMs, there may be mixed social and profit objectives for their vine multiplication activities. The sex composition of the groups (male majority or female majority) did not seem to have influenced the motivations of the groups to continue or stop vine multiplication. However, of the individual DVMs, women were more successful in keeping up their vine selling activities than men. During the project, the husband as head of the household was recorded as the DVM, although much of the work and responsibility was jointly undertaken with the wife. The ending of subsidised support or fewer institutional customers may have influenced men to turn to more lucrative opportunities. For women, "tradition" justified their role in sweetpotato production, alongside training in specialised seed production that provided recognition for their knowledge and skills. The fact that many of the women were single/widowed could lead to an explanation: maybe, they were more in need of the additional income more than the men.

The varieties that persisted best in the system five years after the intervention ended were Polista (white-fleshed) and Kabode (orange-fleshed). This probably relates to varietal attributes (for roots and planting material) and their wide adaptability across different agro-ecologies in the Lake Zone (Okello et al. 2015). Drought and disease tolerance were important varietal traits, but of note was the increasing differentiation among the varieties in terms of use, with the orange-fleshed varieties being used for both novel and traditional sweetpotato-processed products.

The DVMs had two major types of customers: neighbouring farmers and institutions, with differing modes of transaction. While the volumes sold had a small monetary value, this is not to undermine the possible importance of that cash. For women especially, this could represent opportunities for small expenditures ("money for soap") which otherwise could only be done with cash and the consent of their husband. Also, we have little understanding of the degree to which these households are part of the cash and subsistence economies. If the households mostly produce their own food and possibly sell some surpluses, then the little income from vines can play an important role in acquiring food and other items that can only be accessed through the cash economy. The data show that most of the DVMs have also been sharing vines: this suggests that a moral economy is very much present in their motivations and considerations. While the moral economy considerations, together with the vegetative character, and thus easy multiplication, of the planting material could undermine the commercial viability of local seed businesses, our study shows that they do not eliminate the opportunities to earn cash. More than a third of the DVMs are, five years after the project ended, still in business and able to navigate between the cash and moral economy in a way that does not undermine, and can actively promote, the continuation of their vine business. These social norms may also contribute to the persistence of the improved varieties in the system. Immediately after the project ended, the area was saturated with Marando Bora varieties, so farmers did not need to buy until the extended dry periods of 2015–2016 when farmers and DVMs started to lose the varieties. After this, the DVMs who had been able to conserve the varieties were able to benefit as the demand for vines of the Marando Bora varieties picked up. But, only a limited number of DVMs obtained replacement materials, and those that obtained new improved varieties received them through other projects. This points to the importance of DVMs being able to restock their clientele with planting material of preferred varieties and quality – which does require sustained linkages to sources of clean seed and new varieties (Jones et al. 2001; Lukonge et al. 2015). It is also important to have a better understanding of the role of the cash and moral economy in the life of households – and how these are currently changing under influence of climate variations and market developments. This and the group dynamics in relation to keeping in business and maintaining seed quality are two aspects that merit better understanding in order to design viable decentralised multiplication models.

Abbreviations

DVM	Decentralised vine multiplier
NGO	Non-governmental organisation
SASHA	Sweetpotato Action for Security and Health in Africa
TARI	Tanzania Agricultural Research Institute
TSH	Tanzanian Shilling
SSA	Sub-Saharan Africa

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