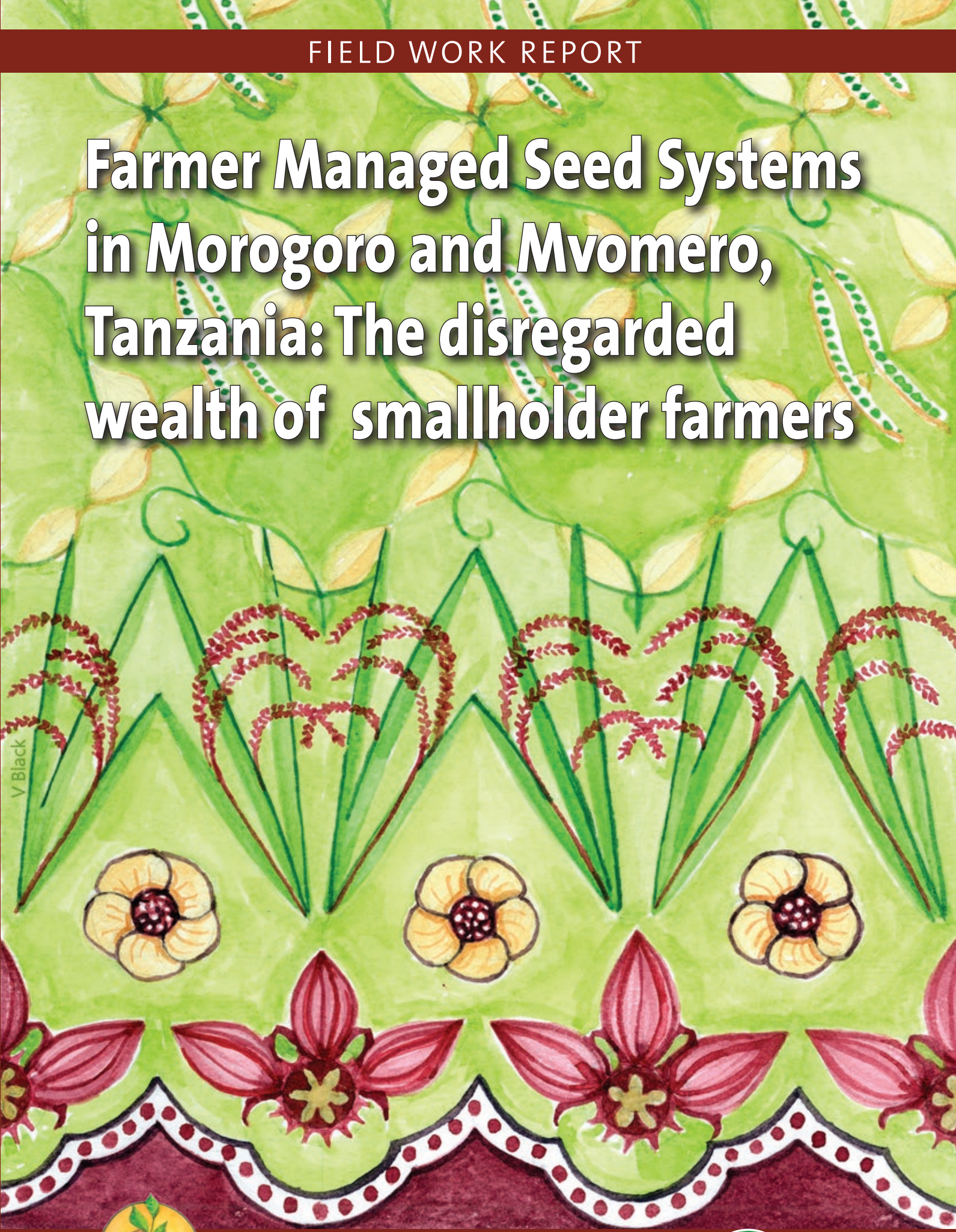
FIELD WORK REPORT

Farmer Managed Seed Systems in Morogoro and Mvomero, Tanzania: The disregarded wealth of smallholder farmers



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On 7 April 2015 the African Centre for Biosafety officially changed its name to the African Centre for Biodiversity (ACB). This name change was agreed by consultation within the ACB to reflect the expanded scope of our work over the past few years. All ACB publications prior to this date will remain under our old name of African Centre for Biosafety and should continue to be referenced as such.

We remain committed to dismantling inequalities in the food and agriculture systems in Africa and our belief in peoples' right to healthy and culturally appropriate food, produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems.

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Acknowledgements

The African Centre for Biodiversity (ACB) acknowledges the generous support of the Swiss Agency for Development and Cooperation (SDC). The views and opinions expressed in this report are those of the authors and do not necessarily reflect the official policy or position of the SDC.

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Acronyms

ACB	African Centre for Biodiversity
AGRA	Alliance for a Green Revolution in Africa
ASA	Agricultural Seed Agency
CSO	Civil society organisation
FAO	Food and Agriculture Organisation of the United Nations
FFS	Farmer Field School
FGD	Focus group discussion
FIPS-Africa	Farm Input Promotions Africa
FMSS	Farmer-managed seed systems
GR	Green Revolution
IP	Intellectual property
ISS	Institute for Social Studies
MVIWATA	Mtandao wa Vikundi vya Wakulima Tanzania
NAIVS	National Input Voucher System
NGO	Non-governmental organisation
OPV	Open pollinated variety
QDS	Quality declared seed
PICS	Purdu Improved Crop Storage
PPP	Public-private partnership
PVS	Participatory variety selection
R&D	Research and development
SAT	Sustainable Agriculture Tanzania
SAGCOT	Southern Agricultural Growth Corridor of Tanzania
SSA	Sub-Saharan Africa
SUA	Sokoine University of Agriculture
TOAM	Tanzanian Organic Agriculture Movement
TSh	Tanzanian shilling
VBAA	Village Based Agricultural Advisor

Use of terminology

In sub-Saharan Africa (SSA) the majority of seed planted by small-scale farmers has been selected and saved from the previous harvest, or sourced from neighbouring farmers in the local vicinity, as well as from local rural trade (McGuire and Sperling, 2016). In Tanzania, in 2015, a nationwide study commissioned by the Tanzanian Organic Agriculture Movement (TOAM) found that farmer-managed seed systems (FMSS) were the major source of seed in all Tanzania's agro-ecological zones—almost 99% of paddy acres, over 93% of groundnut acres and around 93% of bean acres were planted with varieties from the FMSS (TOAM, 2015).

The importance of the FMSS for biodiversity and livelihoods has been highlighted in a huge body of published work produced by Bioversity International and others (e.g. Jarvis et al., 2011; Vernooy et al., 2015). Despite this, the literature refers to FMSS systems as being 'informal', as opposed to 'formal' seed systems, in which seed breeding, production and marketing is highly regulated. Informality is used by proponents of the Green Revolution to imply something that is sub-standard and that must be ignored, radically overhauled, or eradicated altogether. It also suggests an absence of, or a diminished role for the social rules and norms that govern such systems (Coomes et al., 2015). We feel it is more appropriate to replace this terminology with the term 'farmer-managed seed systems'. This concept recognises that farmers are the primary agents in these systems; that farmer control over material resources and processes should be recognised, protected and extended; and that farmers should be treated as equal and active partners in attempts to support their farming practices (ACB, 2015). The concept of FMSS recognises also the ongoing centrality of these systems to food security, nutritional diversity and agricultural biodiversity, rather than some marginal system that is destined to disappear.

Key findings

The farmer-managed seed system (FMSS) is the bedrock of rural livelihoods and agricultural production in Tanzania. While this is recognised by many stakeholders in the agricultural sector, including small-scale farmers themselves, support for FMSS is not forthcoming from a policy environment dominated by a focus on certified/improved seeds and productivity. For example, in many official rice irrigation schemes quantitative production targets are being set, the use of local rice varieties is prohibited, and local training centres actively discourage farmers from using their own varieties.

Research conducted in Morogoro and Mvomero found that a variety of crops and seed are being grown and used, and recorded 91 different varieties of crop, wild plants and trees. Smallholder farmers listed 20 varieties of rice, a major staple in the area, of which 17 were farmer varieties. Maize was the only crop for which certified seed varieties outnumbered farmer varieties. In addition it was found that numerous wild trees and plants are being used for medicinal purposes, including the treatment of malaria, high blood pressure and worm infections, and also as bio-pesticides. Although these wild trees and plants are readily available access to them is controlled and there are both explicit and implicit understandings among farmers regarding the responsible harvesting of these resources.

A finding that has caused concern is the distinct trend toward the disappearance of local varieties. This is due to plant disease, or the pressure that is put on farmers to stop using them, or their displacement by subsidised certified varieties. A number of local varieties of maize, pigeon pea, millet, rice and beans are said to be no longer available in the area. In upland areas, local varieties of cassava and sweet potato are also disappearing, as a result of disease pressure. With regard to non-commercial crops—millet, pigeon pea, cassava and sweet potato—this is particularly alarming, as there is little research investment in these crops. This loss of agricultural biodiversity has the direct effect of reducing nutritional diversity in these localities.

Although knowledge of these varieties has been passed down for generations there is little in the way of systematic documentation that records this information. This deficiency in historical agricultural documentation risks the loss of much of this knowledge in the rush for Tanzania to modernise its agriculture. Our discussions with farmers revealed a clear division between older and younger generations in the current knowledge about local varieties and wild medicinal plants and trees.

Despite constant criticism from donors, policy makers and plant breeders that farmer varieties are sub-standard and anachronistic, smallholder farmers who participated in the study preferred local varieties, for both cultural and agronomic reasons. They cited aspects such as cost, ease of access, aromatic qualities and better resistance to insect pests, as some of the advantages inherent in local varieties over certified seed.

The areas in which our study was conducted appear to have well-established and functioning extension services which, amongst an array of other tasks, act as key pathways for learning and information sharing between farmers and the public sector. Also, the research and development (R&D) division of the Dakawa Agricultural Research Institute offers technical support to farmers and there is a good, functioning network of village-based agricultural advisors (VBAAs) and demonstration plots. Despite these positive elements, the policy environment is systematising support for improved/certified varieties at the expense of farmer varieties, and the entire R&D and extension system serves as a conduit for certified varieties. However, the same institutional architecture easily could be adapted for participatory experimentation on farmer varieties—and there is widespread interest in exploring such a path. Farmers are calling for a more systematic focus on the FMSS by the agricultural extension service, and the public research system offers opportunities to establish working relationships with farmers on participatory variety selection and the optimisation of local varieties. Regrettably, such activities are not funded.

In keeping with the trends described in the literature, farm-saved or exchanged seed and local markets were the primary sources of seed for farmers involved in the study. Visits to local markets revealed a thriving seed trade in a wide range of rice, maize, beans, sorghum, millet, okra and hibiscus, to name a few varieties. Aside from cost and availability, when local farmers access seed they place more trust in neighbours, or known-market traders (many of whom are also farmers), rather than in specialised agro-dealers. Yet, by doing so, farmers and traders are deemed to be engaging in illegal activity—because Tanzania's seed laws prohibit the marketing of uncertified seed. Contrary to the day-to-day realities faced by smallholder farmers, the country's current legislation imposes externally-derived and onerous standards on seed quality and certification.

Historically, farmers in Tanzania contributed seed to the local village chief or headman at the end of each season, which was kept in an emergency store. This practice is dying out and, although isolated community seed banks still operate, these practices have not been replaced with any alternatives. Many small-scale farmers consider that their seed saving and exchange activities constitute a living community seed bank, and there was a consensus that greater official support for such initiatives would be welcomed. Under the prevailing agricultural modernisation agenda, seed production (or multiplication) is considered an endeavour best left to the private sector. In spite of this, our research found a number of skilled seed producers who were producing a range of seed varieties. These included beans, amaranth, African nightshade and other local vegetables. These producers are acknowledged for the quality of their seed, despite having received no external support for their efforts. There was general consensus that Tanzania needs more, and not fewer, producers of farmer varieties of seed.

Participating farmers expressed their clear understanding of and concern for changes to seed laws and policies that will damage the FMSS. They called for greater support from the government and donors for activities that will strengthen FMSS. These included: more documentation of local farmer varieties,

physical centres and demonstration plots; a greater focus by the research and extension system on the FMSS; and increased farmer-to-farmer exchanges. A list of the pros and cons regarding the FMSS, as stated by farmers, appears below:

- Farmers listed 91 crops in current use, with a large number of medicinal trees and plants;
- The main food crops are rice and maize;

Almost all crops are farmer varieties—except for maize which has more certified than farmer varieties;

- Over 70% of certified varieties are maize, with a few certified rice varieties and one certified variety each for cassava, sweet potato, amaranth and tomato;
- A number of varieties are being lost in these areas, including maize, sweet potato and beans. Millet also is falling out of use. This narrowing of agricultural biodiversity has implications for local nutrition and exposes farming households to greater risk because they will have to rely on fewer varieties;
- For household consumption the local varieties for most crops are preferred, specifically because of the aroma and the taste of local rice varieties;
- Traders also prefer local varieties, especially for rice;
- There is a trade-off in improved rice varieties between higher yields and the loss of aroma, which is a significant issue for household consumption and local markets;
- As stated by farmers, other reasons for their preference for local varieties include ready availability, drought tolerance and pest resistance;
- Available improved varieties are generally favoured for their short maturation and yield potential, as well as (in certain cases) disease resistance;

High costs and irregular availability are obstacles to the greater adoption by farmers of certified varieties;

- Extension services demonstrate a narrow focus that encourages farmers to adopt certified varieties, without any effort being given to supporting the improvement of farmer varieties, despite the widespread use of and preference for these varieties;
- Farmer field schools and demonstration plots are used also to encourage farmers to adopt certified varieties. These methods of knowledge exchange and experimentation function well and could be adapted easily for participatory work on farmer varieties;
- The systematic documentation and recording of varieties, their characteristics and priorities, for further improvement by farmers, could be a valuable contribution;
- The Dakawa Agricultural Research Institute has been involved in collecting and characterising local maize and rice varieties;
- Dakawa engages in some activities on participatory variety selection with farmers, and also has land that it would be willing to make available for participatory experimentation on farmer varieties;
- Participating farmers are most interested in experimentation on varieties to retain traits such as aroma and pest resistance, and are eager also to improve yields and reduce the time to maturity;
- Farmers rely primarily on recycling and exchanging seed as their main source of seed;

There is a community seed bank in Hembeti village which could serve as a site for a farmer exchange, to demonstrate the model and to learn from participants;

- Little work has been done on tracing the movement of seed between locations. This is an area with potential for further investigation;
- Traders at local markets indicate that, at times, grain is used for seed; and
- A few individual farmers were identified as engaging in (some) seed production, and some of them have received formal training. These individuals and others could form a core of 'custodian farmers' who could embed this research in different localities.

Introduction

This field report shares the findings of field work carried out in Morogoro and Mvomero in 2016. It is a continuation of the partnership between the African Centre for Biodiversity (ACB), Mtandao wa Vikundi vya Wakulima Tanzania (MVIWATA) and Sustainable Agriculture Tanzania (SAT). The partnership has focused on issues pertaining to seed, particularly the farmer-managed seed system. The first round of research focused on Green Revolution (GR) initiatives and their implications for small-scale farmers.

Objectives of the research included: mapping the crops and varieties in use in the research sites, identifying current or past projects or programmes aimed at promoting FMSS in these areas; and identifying local farmers, organisations or institutions interested in supporting further work on FMSS. The research aims to prepare the ground for practical activities together with farmers, partner organisations and public sector institutions, to facilitate their work on priority areas of FMSS as identified by participating farmers. The goal is to construct multi-year research activities that can provide material support to farmers, specifically to enhance their seed varieties and to support other aspects of the seed system, based on the identified priorities. We anticipate that, over time, this practical base will provide evidence for advocacy that favours the redirection of government policies and programmes towards support for agro-ecological practices that incorporate FMSS.

The report begins with a brief discussion about the research methodologies and then considers the crops and seed varieties being grown in the study areas, as well as their characteristics and uses. Thereafter we provide an initial map of other dimensions of FMSS, including access, selection and production, and the influence

Bean seeds in a market in Mvomero.

of end consumers and processors. In this respect we build on the discourse of food and seed sovereignty, which analyses the discrete components of globalised and localised food systems within a broad systemic critique.[1]

Farmer-managed seed systems are complex because they are embedded in the context-specific social, economic and political relations that constitute rural life, and no single discipline can adequately capture or measure these relations (Coombes et al., 2015). Comprehensive work therefore requires multi-disciplinary approaches. We present here an initial scoping of the topic which begins the process of investigation of the importance of FMSS to farmers in these sites and discusses priority areas for further work. The research is oriented towards practical activities which could inform wider policy processes over time, as well as facilitate knowledge exchange and learning between farmers, partners, the government and public sector institutions. We acknowledge the extent to which the policy space and national agricultural budgets are dominated by the Green Revolution; aim to stimulate debate about the future of agricultural and seed research and policy in Tanzania, specifically, and the African continent, generally; and intend to bring the voices of farmers to the forefront of these debates.

1. For example, two academic conferences, which covered a vast range of topics seen through a food sovereignty prism, were held at Yale University in 2013 and at the Institute for Social Studies (ISS) in the Netherlands in 2014. The important long-term work of international organisations such as Bioversity International on various aspects of seed, including community seed banks and participatory variety selection, is increasingly recognised in the wider food sovereignty movement. Alternative methodologies for innovation in plant-breeding, such as an 'open-source' movement (e.g. Kloppenburg, 2014) are also entering the discourse and awareness of food sovereignty activists.

Research methodology and background to the study sites

The research is a continuation of the partnership initiated in 2014 between the ACB, MVIWATA and SAT. The SAT and MVIWATA members of the research team are graduates of the Sokoine University of Agriculture (SUA). This round of the research expanded the team by including farmer representatives from the Morogoro and Mvomero districts, and dividing the team into two groups of five and six researchers respectively. The farmer representatives were all VBAAs[2] and were included so that farmers were given an active role in the process. Farmers selected their representatives to the team, based on their knowledge and standing in their villages. Farmer representatives were fully committed throughout the process and added significant value to discussions during the key informant interviews and field visits.

We conducted a total of nine focus group discussions (FGDs) (4 in Mvomero and 5 in Morogoro) with farmers and VBAAs, with 10–12 respondents in each group. A total of 82 farmers took part in the FGDs—42 from Morogoro and 40 from Mvomero. Fifty-two female farmers participated in the FGDs (63%) (32 from Morogoro and 20 from Mvomero). The FGDs were categorised into gender and age groups: there were two youth groups (for farmers under the age of 35), two women-only groups, two elders-only groups (for farmers over the age of 50) and one mixed group. The categorisation aimed to acquire a diverse set of views on the operation and importance of FMSS from different groups. The age groups also enabled researchers to capture the historical trends of seed varieties among older, middle-aged and young farmers. The youth FGDs were key to bringing younger farmers into the process, as previous research had revealed that youth are not always interested in attending meetings (ACB, 2015). These farmers came from the Mkindo, Msufini, Hembeti, Kigugu, Dihombo and Mbogo villages in Mvomero, and also from the Kiroka, Soweto, Kenge and Towelo villages in Morogoro and the Morogoro Rural districts.

Key informant interviews were conducted with the following: Dr Sophia Kashenga-Killenga, Principal Agriculture Research Officer and Rice Plant Breeder at the Dakawa Agricultural Research Institute; Moses Temi, principal of the Mkindo Training Centre; Professor Joseph Hella at SUA,[3] village extension officers in Mvomero, a miller/farmer, a seed multiplier, grain/seed traders in the local market and SAT field officers. Visits to a farmer's plot that was being used as a farmer field school (FFS) complemented the key informant interviews and FGDs. In addition, because markets are an important source of grain and seed, the research team visited six local grain markets in the Morogoro region.

Research sites

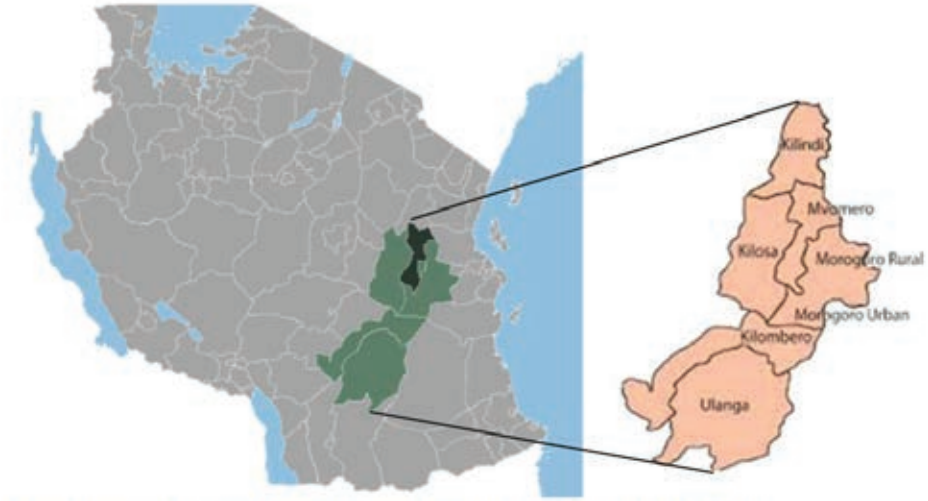
The sites covered two agro-ecological zones, one in the mountains (grouped into the Northern Highlands) and one in undulating hills with relatively fertile soil (in the Southern Highlands). For more detailed information on the research sites see ACB, 2015.

Crops and seed varieties in use in the Mvomero and Morogoro areas

Seed diversity is crucial for farmers in areas with varying agro-ecological conditions, as local varieties have adapted to these conditions over time and agree with the preferences

2. VBAAs are part of a famer-based extension network receiving support from the Alliance for a Green Revolution in Africa (AGRA), USAID's Nafaka, and others. They were established in an AGRA-sponsored micro-dosing project managed by Farm Input Promotions Africa (FIPS-Africa) and continue to play an extension role today (ACB, 2015).
3. Professor Hella was the lead author on a paper produced by TOAM in 2015, titled 'Farmer managed seed systems in Tanzania'.

Figure 1: Map of Tanzania showing Morogoro Region, and the location of Morogoro and Mvomero districts in the region



Source: http://en.wikipedia.org/wiki/Mvomero_District; http://actmorogoro.com/Map_Pull_Out.html

expressed by farmers (Jarvis *et al*., 2000). The local varieties and landraces cultivated by farmers around the world are able to adapt to climate change whereas modern agriculture, which relies on a limited number of crops and varieties (Swisderka *et al*., 2011), is less able to acclimatise. Nevertheless, there is a widely held view that improved varieties contribute to diversity and, consequently, these are in demand by farmers because of their specific traits, such as high yield potential, the demand for which increases with the increasing monetisation of local economies.

However, local varieties are still in high demand from consumers who prefer the taste, aroma and an assortment of other use-related characteristics produced by these crops. A local mill was willing to pay a premium for local varieties because of this. These consumer preferences ensure that farmers will continue to plant local varieties on at least some of their lands. That said, farmers to whom we spoke claimed that various local varieties, including those among maize, pigeon pea and beans, are disappearing. It is hoped that the conservation of local varieties can be encouraged through incentives for farmers to grow diverse crop populations.[4]

Social and cultural contexts shape the control and management of seed diversity and affect farmers' knowledge and their actions and access to resources regarding the maintenance of crop diversity. These contexts are based mainly on age, gender, social status and wealth (Jarvis *et al*., 2000). In the Morogoro and Mvomero areas, both age and gender play a major role in the control by farmers of seed diversity: older generations are more likely to preserve local varieties, while women place greater emphasis on the nutritional aspects rather than the marketing properties of crops (see below). An added gender difference is apparent in situations where knowledge varies between crops and between different landraces within a species. These distinctions may arise from varying uses, preferences or labour regimes that are associated with gender differences.

Farmers involved in the study identified a wide range of local varieties and indicated that local varieties were predominant even in major cereals, such as rice, with only a few improved varieties coming from the formal and public sector. Participating farmers listed 91 crops in current use, including a large

4. Jarvis *et al*. (2011) hypothesise that "landraces will only be grown when they have unique qualities that urban consumers or export markets value, and only if these same qualities cannot be easily transferred into modern varieties".

number of medicinal trees and plants (Table 1). These crops are categorised into cereal, tuber (root), leguminous and pulses, oil, vegetable, fruit, and medicinal trees and plants. In both research sites medicinal plants were abundant in comparison with other crops, followed by vegetable crops and fruit crops.

Table 1: List of crops grown in the Morogoro and Mvomero sites

Type of crop	Number
Cereals	4
Root crops and spices	5
Leguminous crops	3
Oil crops	3
Vegetable crops	15
Fruit crops	14
Medicinal trees and plants	47
Total	91

Under each of the main crops participating farmers identified the local varieties, certified open pollinated varieties (OPVs) and the hybrids they were using on their farms. Nearly all the varieties in use are farmer varieties, with maize having the highest number of certified varieties (Table 2). A total of 77 varieties of the most common crops were mentioned, comprising 57 local varieties and 20 improved varieties. Maize and rice are the most common crops grown in the two sites. These are also the two most important commercial crops in the Morogoro and Mvomero regions, and are key targets under the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) initiative (ACB, 2015).

Table 2: Number of varieties grown in the Morogoro and Mvomero sites

Crop	Farmer varieties	Improved varieties
Rice	17	3
Maize	10	13
Sorghum	2	-
Millet	1	-
Cassava	4	1
Sweet potato	1	1
Cowpea	2	-
Pigeon pea	3	-
Beans	5	-
Soya	3	-
Amaranth	4	1
Tomato	1	1
Totals	57	20

The most common variety of rice is Supa, which has four farmer varieties and one improved OPV (Table 3). Farmers have cultivated these varieties over many years. In the 2014 national varietal list there is only one record of Supa, which was released before 1950 by Katrin ARI in Ifakara—this may refer to the Supa Ifakara variety. Within Tanzania variety names change by geographic location which makes it difficult to trace the movement of varieties between regions, even though our research found this a common occurrence. Some varieties are known to be disappearing, an example being the rice variety, Supa India. For maize, improved OPVs and some hybrids are in widespread use. Other crops have limited diversity, ranging from just one variety (millet) to five (beans). This reveals the fragility (within even the major crops) of agricultural biodiversity and, consequently, local nutritional diversity. Millet is a disappearing crop among the research sites and the reasons for this need require further investigation.

Medicinal plants and fruit crops

In addition to local seed varieties for staples, rural communities supplement their diets with a variety of fruit and nuts from trees and wild plants. Fruit crops recorded were mango, pawpaw, orange, banana, jackfruit, breadfruit (mshelisheli), watermelon, pineapple, avocado, passion fruit, lemon, soursop, guava and tangerine. There appears to be a mixture of 'local' and improved trees in the area. A farmer explained that improved coconut and mango trees from Tanzanian research stations produce more fruit in the short term but they stop producing after four or five years, whereas local trees produce less fruit but over much greater time periods. He said that a coconut tree planted by his father in 1971 is still producing coconuts.

In Mvomero and Morogoro the most common wild trees and plants mentioned were

Table 3: Farmer and certified cereal, legume and vegetative crop varieties[5]

Crop	Farmer varieties	Improved OPVs	Hybrids
Rice (paddy)	Supa Shinyanga, Supa India, Supa Mbeya, Supa Ifakara, Mbawa mbili, Rangi mbili, Shingo ya Mwari, Domo la Fisi, Moshi wa Taa, Kihogo, Tule na bwana, Mwarabu, Nondo, Shingo ya kuku, Cheza, Seselolunyukwi, Sindano, Meli nyeupe, Kongo, Karafuu	Supa, TXD 306 (Saro 5), Nerica	
Maize	Katu mbili, Plenda*, Ilonga Kito, Kitweeko, Mhingo, Manjano, Kimekele, White Tango, Colman, Kihingo*	Staha, Ilonga, Katumani, TMV1, NATA, MMCLU, Situka, TAN 254, TAN H 600, TAN 236	Pannar, SeedCo, Kifaru
Sorghum	Kalashi, Kibangala		
Millet	Mdeha*		
Cassava	Manyanga, Kibanga meno, Moshi wa taa, Kibanga meno	Cassava	
Sweet potato	Bwarabwara*	Sweet potato	
Cowpea	Kisasamali, Luswaluswa		
Pigeon pea	Balongo, Pombwe, Kwazu		
Beans	Machale, Gololi, Kombati, Kisengo*, Kasafaringo		
Soya	Mfawima, Gairo, Njano		
Tomatoes	Tonogwe	Asilla	
Amaranth (Mchicha)	Bwasi, Mchicha Mweupe, Mchicha chakaya	Mchicha lishe	

*Lost/disappearing varieties

mwarobaini (neem), aloe vera, *mkwizingwi* and *mlongelonge* (see Appendix 1 for full list). Medicinal crops are used to strengthen immunity and to treat common ailments such as diarrhoea, worm infections, malaria, toothache, high blood pressure and skin problems. Other plants, such as ukupa and mwarobaini are used also as pesticides and to preserve grains after harvest. In addition, wild legumes are used to treat stomach ache while the bark of the cashew plant is used to treat toothache.

Access to medicinal plants and their wild relatives was not a concern for the farmers because these were easily available in the village or forest areas. However, in order to obtain access to some of the trees in the forest, community members must apply for a permit from the forestry officer at the village office. There are some specific rules and regulations related to the way some of the medicinal plants and trees are harvested for their leaves and roots, seeds and barks. Most of the fruit crops mentioned are seasonal and are not necessarily found in the farmers' plots.

The availability of a host of wild plants and trees, many of which are used medicinally, provides a valuable service in these areas—the nearest government clinic is often several hours travel away. No doubt they provide numerous other biodiversity and ecosystem service-related benefits which have not been captured in this study. That recent international discourse around agriculture has started to

5. Improved varieties are those bred by research institutions, and multiplied, certified and distributed by private companies through agro-dealers and other channels. These include hybrids and improved OPVs.

take health and nutrition seriously (World Bank, 2015) is a welcome development. However, this new agenda may focus too narrowly on specific interventions, such as nutritionally enhanced or bio-fortified staple foods (Valente, 2016). Such an emphasis could result in the marginalisation of a wide variety of other plants in use, by channelling resources exclusively to a handful of crops, with a consequent decline in the use of the wider range of crops and an ensuing loss of biodiversity.

Biodiversity loss

Traditional knowledge is a key factor in FMSS and will be even more so if this continues to be passed from one generation to another. The study sites provided evidence of a marked inter-generational discrepancy in the knowledge of local seed and wild plant varieties, with younger farmers generally having only a rudimentary knowledge, compared with their elders. There is no doubt that macro-level socio-economic changes, coupled with a distinct focus on certified seed and productivity in local agricultural training centres and programmes, are the major factors driving this. There is a genuine risk that much of this knowledge will be lost if policies and incentives at the local and national levels are not put in place, in the near future, to protect traditional knowledge. This will require both political will and technical support.

The spread of crop varieties from one farmer to another is informed by the careful observation of varieties growing in farmers' fields, or by learning about them from other farmers and relatives. This facilitates farmers' exchanges and the spread of local seed varieties from previous generations, over time. Other factors such as household and market demand also shape the use of local varieties.

Agricultural policy, economic status, agronomic and climatic changes have impacted the way in which farmers conserve and use local varieties. Regrettably this impact has led also to the disappearance of some varieties. Despite the large number of farmer varieties mentioned, particularly by older farmers, most of these were no longer being cultivated and thus are deemed to have been lost. A few local varieties are still being grown by a small number of farmers, but this varies from crop to crop. In regard to rice varieties, the very few farmer varieties still being cultivated are the varieties known as *Mbawa mbili* and *Shingo ya Mwari*.

In the Mvomero site most of the varieties deemed to have disappeared over time were among maize and pigeon pea. In Morogoro farmers mentioned the loss of a millet variety (*Mdeha*), beans (*Kigoli* and *Kisengo*—tall red beans with holes like cashew nuts—and Kasafarigo which resembles Kombati), and maize (*Kihingo* and *Plenda*). According to Professor Hella of SUA, two varieties of rice—*Kihongo* and *Moshi wa Taa*—are also disappearing.

In the Mvomero site most of the cassava varieties being cultivated are local, but there are also disappearing varieties, such as *Kibanga Meno*, which is soft and thus easily attacked by the cassava mosaic disease. This was the same case for a sweet potato variety known as Bwarabwara in the Morogoro site.

In the Morogoro site farmers mentioned that a soya variety (name unknown, with grey spots) introduced into the area in the 1980s, overtook the *Kisengo* bean variety, because there was a general preference for soya bean over common beans. Soya is preferred to beans as it is easily marketable, and consumers generally do not suffer from bloatedness after consumption, as is the case with beans. *Kisengo* was regarded as having been lost in the area in 2000.

In Morogoro a group of farmers felt that the proliferation of certified seed, arising from the Kilimo Kwanza initiatives which include the National Input Voucher System (NAIVS), had caused the loss of most of their local varieties. Farmers are encouraged by extension and policy makers to adopt the new varieties of improved seed and to abandon local varieties—which policy makers and extension services describe as being of poor quality, low yielding and disease-ridden.

Farmers expressed the concern that unless greater value is assigned to their local varieties, by the public sector, many more varieties will be replaced by costly certified varieties. Farmers felt that the government was making a deliberate effort to create farmer dependency

on hybrid/improved seed. In Mvomero the lead farmers were convinced they could revive their local seeds in farmer field plots. However, this initiative will also depend on the willingness of other farmers, extension officers and local non-governmental organisations (NGOs) that work in the area, to support these farmer groups. In the current policy environment attempts to revive local varieties may be opposed by Tanzania's fledgling seed industry.

Major features and characteristics of local varieties

"We know how they will grow until they reach maturity, they are ours, we are used to them and know them very well."
SAT focus group

Despite widespread assumptions throughout the 1970s and 1980s that farmers' varieties would be replaced by certified, 'modern' varieties, in much of the global South this has not been the case. Substantial evidence exists in academic, policy-oriented and the grey literature that "significant crop genetic diversity continues to be maintained in farmers' fields in the form of traditional varieties" (Jarvis *et al*., 2011:126). These varieties are used for a number of reasons to overcome environmental and economic selection pressures, including their adaptation to marginal or specific agro-ecologies, post-harvest characteristics such as processing or taste, dietary or cultural requirements or their ability to grow without the application of costly external inputs such as fertilisers or pesticides (Jarvis *et al*., 2011).

A nationwide survey conducted with farmers during 2015 by TOAM found that price and availability were two of the most significant factors influencing farmer uptake of local seed. However, more than 25% of respondents also reported 'reliability' as an important factor in their decision to use local varieties, while 15% reported that local seed had good yield potential under local conditions. Taste and aroma were also important factors (TOAM, 2015).

In the present study it was clear that, despite the focus on improved varieties from both the public and private sectors in Tanzania, small-scale farmers are still very attached to their local varieties, for both practical agronomic reasons and cultural considerations. This is not to dismiss the challenges associated with farmer varieties, many of which were raised by farmers to whom we spoke, but there is clearly a desire to continue using local seed.

The high cost and irregular availability are frequently given as reasons for the low adoption rates of improved seed; conversely, these are cited as distinct benefits for the continued use of local varieties. Local seed is available from a farmer's own saved stocks and in many instances it is also readily available from neighbouring farmers, while local markets are also an affordable and accessible source of seed. Also, farmers felt that local varieties are more adapted to local conditions and soil types, require fewer expensive external inputs and less water—although the long maturation periods of local varieties is becoming problematic as rains become more unpredictable (see below).

Virtually all participating farmers preferred the taste and aroma of local varieties over improved varieties[6] and public sector researchers acknowledged this, though their opinions varied. Moses Temi, principal at the Mkindo Training Centre, argued that this focus on aroma was holding back agricultural productivity; the Principal Research Officer at Dakawa Research Institute accepted that "we can't run from the truth that most Tanzanians eat rice by aroma" and called for a more balanced approach to improved and local varieties. The popularity of local varieties,

6. It should be stressed here that this comparison applies only to rice and maize in instances of both local and improved varieties being grown. The cultivation of improved varieties of other crops was virtually non-existent among the farmers to whom we spoke.

arising from their aroma, also ensures they are always in high demand from traders and processors.

The use of specific varieties is based on a number of factors, including food consumption, commercial purposes, climatic (environmental) conditions and variety characteristics. Farmers preferred mostly the local varieties and OPVs, because they fetch high prices and are in demand at the markets, especially rice, on account of its taste and aroma. The semi-aromatic improved rice variety known as TXD 360 (Saro 5) is grown predominantly for commercial sale, as local varieties are preferred for household consumption. Farmers indicated that local rice varieties are more drought tolerant and require less water compared with improved varieties. However, if short-maturing, improved varieties are used in irrigation schemes, farmers can grow at least two crops per year, whereas local dryland varieties take 6–7 months to reach maturity.

In Tanzania maize is rain-fed and highly dependent on adequate water and moisture content. Improved maize varieties take no more than three months until harvest, while farmer varieties take at least six months to mature. There is a high risk of encountering maize losses when planting local varieties, compared with improved varieties. Local OPVs of maize such as Staha were preferred as they are drought tolerant and not easily attacked by pests when stored.

Gender preferences also inform the selection of crop varieties. According to Professor Hella from SUA, most women will choose 'spreading' cow-pea varieties which are long maturing, because these will provide leaves during the season which women can use as a source of vegetables for their households. On the other hand, men will prefer the 'non-spreading' cow-pea varieties which are early maturing, as these will be grown for grain. Women prefer small-grain groundnuts because these have high oil content and can be used for culinary purposes, while men prefer large-grain groundnuts because they fetch higher prices at the market. Men prefer the climbing bean varieties as they are high yielding and can be harvested continually for 3–4 months.

Participating farmers spoke about the perceived shortcomings of their local varieties, which focused mostly on lower yields and long maturation periods (these are becoming critical now, as rainfall patterns become more unpredictable). These were generalised observations with some deviations. For example, SAT field officers said they have seen some local maize varieties outperforming improved varieties.

It is widely understood that the continual recycling of seeds will impact on harvest size, though the significance of this varies by crop. For example, the yield drop from the continuous recycling of cuttings from vegetatively-propagated crops (such as sweet potato or cassava) is considered not as important as the yield drop that occurs in maize and rice. This could be because maize and rice and more likely to be marketed, but also because it is more difficult to acquire accurate measures of the yields from vegetatively-propagated crops.

Farmers generally agreed that the majority of local crop varieties are long-maturing and that this is becoming problematic due to the increasing inconsistency of rainfall patterns. Though some early maturing rice[7] and maize varieties were mentioned in FGDs, the impression given was that farmers require early maturing varieties, the majority of which are improved varieties. A farmer mentioned that 'in very hot and dry periods we are unable to harvest local maize'. Some of the strongest demands from farmers were for their local varieties to be optimised for yield potential and early maturity.

Pests and diseases presented a mixed bag for both improved and local varieties. Disease is considered a major problem for local varieties, while insect pests are a major problem for improved varieties. Silenge disease (ugonjwa wa njano), for which officially there is no

7. *Shingo la Mwari* and *Mbawa Mbili* were said to be early maturing local rice varieties.

Farmers preparing demo plots at a Farmer Field School in Msufini -Mvomero.

treatment, is an issue in the area. If a field is infected with Silenge (the yellowing of plants is one of the more obvious symptoms) farmers have been instructed to remove the infected plants and burn them. Farmers have been told by local extension officers that there is no cure for the disease, though some still use ash to treat infected areas and this is said to have some positive impact. Another technique involves planting tete (a plant similar to sugar cane) close to the infected area. Again, there is no hard evidence that this works but farmers said they found it 'comforting'. Farmers said improved varieties generally are more susceptible to pest infestation, both in the field and during post-harvest storage. Further research could be done to identify the causes for this, e.g. whether this is due to inherent genetic characteristics of local varieties, or because of agronomic practices, or a combination of both).

Extension services and knowledge of farmer varieties

In Tanzania the public agricultural extension service plays a vital role in providing information and training to farmers, and for transmitting information between various levels of local, regional and national government. Extension officers focus on all aspects of agricultural practices, from land preparation to post harvest, and are conversant with all types of crops, with a particular focus on rice, maize, sunflower of different varieties, and crops such as sesame and vegetables. Specialisation by extension officers on specific crops depends on the focus crops in a given area.

Conventional extension approaches have attracted criticism for their limited focus on the demonstration of technologies, their constrained use of farmers' knowledge, and for using the packaged information generated by the Ministry of Agriculture (Mvena *et al.*, 2013). This is especially evident when it comes to seed, as extension support is usually limited to improved seed. Extension officers frequently advise farmers to buy new improved seed as

opposed to supporting the selection of seed from the previous harvest.

In the irrigation schemes, for example, extension officers emphasise the use of improved varieties and not local varieties, despite the widespread use of local varieties. Both researchers and extension officers demonstrate a primary interest in enhancing the uptake of new technologies by farmers (Mvena *et al*., 2013). The older extension officers display a certain level of knowledge and experience regarding indigenous knowledge, but policy dictates what they teach in the farmer field schools and they are actively discouraged from advising farmers about these so-called 'outdated technologies'. However, this study found that in some cases, at a personal level, they have reasonable knowledge about local varieties. When this generation of extension officers retires, it will be replaced by younger extension officers who lack sufficient knowledge or recognition of the ongoing value of local varieties.

Farmer Field Schools (FFS) and demonstration plots

Farmer Field Schools (FFS) are an important avenue for the transfer and sharing of knowledge on seed selection between farmers. The main component of Farmer Field Schools (FFS) is the use of demonstration plots—these are considered a key element for farmer-to-farmer knowledge exchange and the transfer of agricultural technologies. Demonstration plots usually belong to the VBAAs and are supported by extension officers in the area. Generally a FFS will comprise no more than 20 farmers, so they are easily manageable, with the VBAAs acting as lead farmers.

Extension officers work with farmers through the FFS, and sometimes with individual farmers when the need arises, but mostly priority is given to the VBAAs. In cases where the extension officers are not easily available the VBAAs act as farmer trainers and dispense advice to fellow farmers. Consequently, VBAAs must ensure that their plots are strategically placed so as to be accessible to farmers outside the FFS. Demonstration plots are used also on farmer field days, when farmers from different villages meet with government officials and other stakeholders. Farmer field days offer learning opportunities for farmers regarding different agricultural practices, including farm preparation, planting, the application of fertilisers and pesticides, weeding, harvesting and seed selection.

Farmer Field Schools are used also as seed production plots for the multiplication of quality declared seed (QDS) and other local varieties. In the QDS system small-scale farmers can produce and sell seed in a smaller administrative area with less onerous quality standards than full certification. The main crops produced through QDS in the study sites were maize and rice. In the past training on QDS production was provided by Dakawa, through the local village government via its extension officers and the FFS. Mkindo Training Centre based in Mvomero also offers training on improved seed production. In 2013 and 2014 Mkindo, via MVIWATA and the Nafaka project, trained farmers in the FFS. At present there is no specific support for FMSS from public research and extension programmes.

The primary centre of learning for farmers in Mvomero is the Mkindo Training Centre. According to its principal, attendance at the Centre by local youth has increased dramatically in recent years, as livelihood opportunities elsewhere have become more limited. Once at Mkindo, young farmers are exposed to knowledge of certified varieties only; the use of local varieties is positively discouraged—and prohibited in formal rice irrigation schemes that operate close to the centre.

Mr Bakari, one of the VBAAs, and his farm.

Case Study: Farmer Field Schools and a Demonstration Plot for Mr Bakari

The research team visited one of the farmer field schools in Mvomero belonging to Mr Bakari, a VBAA. The demonstration plot exhibited three different varieties of rice—Supa India, *Shingo ya Mwari* and *Supa Shinyanga*. Mr Bakari is planning to add a fourth variety, Saro TXD 306, for QDS multiplication. He is permitted to sell the QDS seed but not the farmer varieties—it is illegal to sell any seed that is not certified. Despite this, the Supa *Shinyanga* and *Shingo ya Mwari* varieties are those most preferred by consumers and traders ,due to their superior aroma and taste, respectively.

Plant improvement

There has been a concerted effort in recent years from the donor community, underwritten with substantial financial investment, to strengthen public sector plant breeding in sub-Saharan Africa. Maize, a staple crop throughout much of the continent, has attracted the lion's share of investment, particularly concerning public-private partnerships (PPPs), while research into other grain crops, legumes and some vegetatively-propagated crops has also been supported (Food and Agriculture Organisation (FAO), 2010; ACB, 2015). Significantly fewer resources have been channelled into improving varieties deriving from and intended for use in the FMSS, that is, varieties that will remain under the control of local communities, rather than be subject to the intellectual property (IP) and certification regime of the commercial seed sector. This produces an orientation towards standardised varieties for use across wide areas, in order to realise economies of scale and justify investment. However, many of the varieties favoured by farmers are adapted for localised contexts. It is suggested that less resource intensive means could be used to connect farmers in these localities to technical support, to experiment on these seeds and exchange both materials and knowledge with farmers in neighbouring areas, where local varieties may have dwindled but nevertheless could play an important role.

Jarvis et al., (2011) have previously argued that the use of varieties within the FMSS could be increased if these local varieties were better characterised, the varieties themselves could be optimised, and if agronomic management practices for farmer's varieties were improved. Our research has recorded a great deal of information about the characteristics of farmers' local varieties, which was freely shared by research participants, particularly by the older farmers. However, we could find no evidence of any written records of these characteristics.

The Dakawa Research Institute, which has a research mandate for maize, rice and vegetables, has initiated efforts to record and characterise the astonishing diversity of farmer varieties. According to Dr Kashenge of Dakawa, over 100 local varieties of rice have been collected within Tanzania, thus far, and similar efforts are underway at some of the other (fifteen) research stations in the country. However, Dr Kashenge informed our researchers that the lack of financial resources has so far prevented any country-level consolidation of this information. This element (consolidation) will be particularly important, given that it is common for a variety's name to change from village to village, despite it having very similar characteristics.

Participatory variety selection (PVS) has been used extensively in recent years in numerous countries, including Ethiopia (van de Gevel, 2013), Syria, Jordan, Egypt, Eritrea, Algeria, Iran (Ceccarelli & Grando, 2006) and Nepal. Its use is intended to improve the local farmers' varieties being used in low input systems. Also, there is evidence that new varieties arising from such programmes are more likely to spread throughout existing seed systems (Jarvis et al., 2011). Dakawa is currently engaging in PVS: a small number of farmers are involved in the early stages of selection, prior to the inclusion of a slightly larger group (normally around 20–30 farmers) who first observe the few varieties shortlisted for release being planted and grown, and then grade and characterise the varieties in the field. The group

then participates in harvesting, preparing and consuming the selected varieties, to characterise and assess post-harvest traits. Dakawa makes an effort to ensure these participatory groups are gender balanced and comprise a cross section of farmers, including some farmers who also trade and mill rice commercially, because desirable traits can vary considerably across gender and other social lines.

Throughout our research many participants expressed a desire for improvements to be made to their local varieties, for increased yield or early maturity, for example, without losing their desirable traits such as aroma or the resistance to certain insect pests. These wishes were also expressed to some of the public sector officials during our interviews, who responded with varying degrees of sympathy. At Dakawa it was explained that, for example, increasing a variety's yield potential without losing its aromatic quantities would be 'very challenging', but not impossible—if there was an adequate pool of stable genetic diversity from which to draw. It is encouraging that some officials, at least, were open to such ideas and happy to hear these requests from farmers.

Ostensibly there is potential for connections to be made and work to be done, but resources will need to be mobilised. Most of Dakawa's funding comes from donor support or the income generated from seed multiplication. A recent (now concluded) round of funding from the Alliance for a Green Revolution in Africa (AGRA) was used to collect and maintain rice varieties and resulted in the release of a new salt-tolerant[8] rice variety, Sato. Dakawa anticipates additional donor funding during 2016, which is expected to revive more breeding programmes, including for vegetables. However, this funding uncertainty serves to highlight the precarious position in which many of the public sector breeding programmes find themselves, throughout SSA.

There is clearly a desire on the part of Dakawa to work with farmers and their FMSS, but the current policy and funding environment, with its emphasis on improved varieties and PPPs, is not conducive to this. Successful and transparent participatory/collaborative breeding programmes will require long-term, stable funding if they are to make necessary, meaningful and lasting improvements to farmers' varieties.

Accessing seed

In SSA the vast majority of seed planted each season derives from seed that farmers have selected and saved from the previous harvest. Estimates from East Africa put the figure at somewhere between 60% and 80%, rising to almost 100% for indigenous vegetables, pulses, vegetatively-propagated crops and certain cereals, such as millet and sorghum (ACB, 2015b). In Tanzania the use of saved seed ranges between 76% and 90%. Our earlier research in Morogoro and Mvomero revealed that 80% of farmers surveyed were practicing seed saving (ACB, 2015a). McGuire and Sperling (2015), drawing upon "the largest specialised seed dataset in the world", from five countries in SSA and Haiti, noted that, despite a sustained focus in policy circles to increase the adoption of improved seed, over 90% of the seed in use came from outside the commercial sector. Of further significance, local markets proved to be the source of over 50% of the seed in use at the time of observation (McGuire and Sperling, 2015).

Many of these observations were made following periods of acute environmental or socio-economic stress (for example, in Haiti and Zimbabwe) which could explain the very high numbers for market access. Much of the seed purchased from local markets came from farmer saved seed and our field work has reinforced this information, illustrating the crucial role played by FMSS (including interactions with local markets). It also illustrates the importance of deepening our

8. Soil salinity is an increasing problem in irrigated rice production in Tanzania. According to Dr Kashenge of Dakawa, this problem is exacerbated because it is extremely difficult for farmers to detect in the field, without access to soil analysis.

understanding of how these markets function, how farmers interact with them, and why they choose to do so. What we have produced here is just a start to a complete mapping of the many and complex relationships within FMSS.

Seed storage and community seed banks

In recent years much attention has been given to community seed banks, as an alternative to the agro-dealer-driven model supported by the Green Revolution. Community level seed-saving initiatives have been around, in various guises, for about 30 years. With their focus on local varieties, these initiatives have been designed and implemented to conserve, restore and revitalise local seed systems, and to increase the control of farmers and local communities over these systems (Vernooy *et al*., 2015).

According to Professor Hella of SUA, farmers in Tanzania historically have contributed seed to the local village chief or headman at the end of each season, to be stored in case of emergencies. This practice is dying out and was not mentioned by farmers involved in the present study. This is indicative of the long-term social change occurring in Tanzania, and more widely on the continent as 'mega-trends', which include urbanisation, population growth and climate change, which alter previously stable social structures. It is not exclusively an agricultural issue.

At present, if community seed banks are operating at all in Morogoro and Mvomero, they are doing so discreetly and in isolation. In Mvomero farmers said there was no history of community seed banks in the area and that this was 'new terminology' to some of them. Farmers in Morogoro identified a 'cereal crop bank' in Hembeti village, which is geographically closer to the Mvomero farmers. Farmers own shares in the seed bank and pay a storage cost of 500 Tanzanian Shillings (TSh) per bag for the upkeep of the bank. Farmers appeared to be satisfied with the service and there had been a small increase in membership, from 50 farmers in 2015 to 60 (so far) in 2016, with new members being registered on a continual basis. Time and resource constraints prevented a more detailed investigation of this aspect, although follow-up research could investigate it further, if appropriate and/or desired by farmers. While there was little in the way of formal seed banks or structures, discussions among study participants revealed that farmers frequently access and trade seed amongst themselves, and some participants argued that this was, in fact, their community seed bank.

Farmers mentioned different methods of storage including silos, special polythene bags known as Purdu Improved Crop Storage (PICS), and metal barrels in the ceiling and/or the kitchen, where smoke is used to preserve the seed and prevent attacks from pests and diseases. The PICS bags have been promoted mainly by the government, can be used to store both grains and seed, and give up to 10 months of storage. The bags are manufactured in Arusha and Tanga but farmers found them expensive, at around US$ 2 (TSh 4 000) each, and they are not always available.

Local markets and access to seed

The 'organic' movement of seed between regions is another important but sporadically documented source of dietary and biological diversity in FMSS. This transfer may bring the risk of plant disease but it could be managed with appropriate information and tools. While nothing on this topic has been officially documented, some farmers in both the Mvomero and Morogoro study sites were very knowledgeable about these geographical seed flows. A local maize variety known as Kimekele is said to have been introduced into the area before the 1970s, though nowadays it is becoming increasingly rare. Other introductions have been more recent, for example, a maize variety known as White Tango, from the mountains in Kisoso, which farmers in the Morogoro groups had started cultivating in 2008. One of the local markets we visited was trading Groundnuts varieties said to be from Malawi.

Farmers said that local markets were an important source of seed. In order to gain better understanding of how farmers engage with local markets to access seed, and in addition to questions asked during the FGDs, the research team visited four local markets in the study area, and field officers from SAT spoke to a market stall owner who sells seed.

Grains on display in a market in Morogoro.

Traders sell a wide variety of rice, maize and beans for consumption, but at least some of this is used as seed, even though this is technically illegal in Tanzania. Some traders (who are also farmers) selected grain that is most appropriate for seed, told us how often some of the seed/grain had been recycled, and offered advice on the best ways to plant the seed. Traders showed us a wide selection of other seed they were selling, including local and improved varieties of amaranth, wheat, pumpkin, sorghum, pearl millet, millet, popcorn seed, okra, hibiscus, butternut, tomatoes, castor and hibiscus. Some of these seeds came from the traders' own farms.

Farmers gave several reasons for purchasing seed from local farmers' markets as opposed to agro-dealers. These included the cost (agro-dealers were said to be up to four times more expensive than local markets), that seed from the markets is not treated with chemicals, and that they have achieved higher germination rates from seed from local markets than the seed from local agro-dealers. This is based on interactions with a very small number of farmers and cannot be said to apply across the board, but it does challenge the generalised assumption that all farmer seed is of poor quality and needs to be replaced with improved varieties. It must also be stressed that trust plays a vital role in these transactions at local markets.

Concerns over quality standards in seeds are valid, particularly for small-scale farmers who will suffer the most if the seed they purchase does not perform as expected. But, rather than imposing imported quality standards and distribution models, would it not be more prudent to recognise and work with existing structures? Current efforts to impose seed trade and IP laws that have been constructed outside the country, which are more appropriate to conditions in the global north (where they also generate considerable controversy) highlight the extent to which the current 'modernisation' agenda in African agriculture is out of touch with conditions on the ground.

Seed selection and production

As previously discussed, policy is oriented towards the production of certified seed which, in Tanzania, is restricted mainly to commercially lucrative grain and horticultural

crops. Government interventions to increase the quantity and variety of certified seed production, such as the establishment in 2006 of the Agricultural Seed Agency (ASA), have had limited impact so far. A government programme to license basic and foundation seed production to the private sector has also failed to make much headway thus far (ACB, 2015).

The QDS system operates and is recognised in legislation in Tanzania. Discussions have taken place between government officials, farmers and civil society organisations (CSOs), to expand the geographical scope of the QDS system, but this has drawn criticism from the private sector and parts of the public sector. According to Professor Hella, many QDS producers struggle to sell QDS seed in their own villages as their seed is not trusted. However, farmers participating in the study held positive opinions of the QDS system.

The focus of the field work was on farmer activities outside these formal systems. In Morogoro the SAT field workers spoke to a number of farmers who were producing seed for distribution, including beans, amaranth, African Nightshade and other indigenous seeds. By and large these seed producers were doing so without any formal assistance or training, yet their seeds were very popular locally. In Mvomero we spoke to a farmer, Mr Sadick Mohammed, who had earlier multiplied local maize seed, over a period of some 20 years, up until the mid-1990s. While working at a research station in Bagamoyo, Mr Mohammed had received extra training in seed multiplication and had put this to use in his village, multiplying local maize varieties *Kile* and *Kitkweko* (the latter is distinguished by its purple and white kernels). At that time his seeds were very popular in the local vicinity due to their high germination rates.

Farmers have a range of different approaches to variety selection, determined largely by their own knowledge and the type of crop. While some farmers prefer selecting seeds on their farms before harvest, others prefer selecting after. According to Professor Hella seed selection is key, and the best approach is to select seed before rather than after harvest (especially for maize and rice).

In a highly animated conversation with the two farmer members of the research team, Mr Mohammed explained, to nods of approval from the accompanying VBAAs, how he selected seeds only from cobs of uniform colour, taking them from the middle of the cob where the kernels are largest. To ensure varietal purity by avoiding cross-pollination with other varieties, seed was taken only from the centre of the field. Mr Mohammed explained that an isolation distance of 200 metres is crucial to ensure varietal purity, and that previously, when he had owned 8 acres (approximately 3.2 ha) of land, he had been able to farm maize according to this recommended isolation distance. However, at present he owns only 2 or 3 acres (0.8–1.2 ha), which is not enough to engage in seed production. This, together with irregular weather patterns, is one of the main reasons why Mr Mohammed no longer multiplies seed.

The average land holding in Mvomero is around 2–3 ha which presents a challenge (a not insurmountable challenge) to the production of farmer varieties in the area. There was general consensus among local members of the support team that the establishment of local seed producers would be highly beneficial, as 'the quality of maize seed has declined'. But the success of this approach would require a good supply of pure local varieties and currently most of the local varieties in use are deemed not to be pure (or true to type).

Rice is a good example of a crop whose seed is selected before harvest. Again, farmers select the seed from plants located at the centre of the plot, as these are less likely to have cross-pollinated with other varieties from neighbouring farms, although some farmers preferred selecting from a different section on the plot. Once the area for seed selection has been established, the farmer removes the off-types and proceeds to harvest the selected section. (An 'off-type' is a plant that differs in one or more traits (the colour of the flower, height, etc.) from the cultivar from which it was derived.) Harvesting includes the process of threshing (separating the grain from the straw) and winnowing (removing the chaff). The harvested rice is then dried, bagged (in specific labelled bags) and stored. Younger farmers mentioned a different process for rice

seed selection, which takes place during the planting season, and indicated that they had learned this method at the Mkindo Training Centre. Rice seeds are floated in a container of salty water; the seeds that float are discarded; the seeds that sink to the bottom of the container are rinsed thoroughly in clean water and then dried or planted immediately. A similar technique has been fully described in a report on FMSS by TOAM (2015).

Other crops, such as amaranth and hot pepper, do not require seed harvesting and are pollinated through natural methods. Women appear to be more involved in seed harvesting and storage, but this varies depending on the variety of the crop and its use. Once seeds have been selected they are properly dried and stored, or they may be planted immediately, depending on the type of crop. Farmers understood the importance of completely drying the seeds of most cereal crops before they are planted.

The issue of varietal purity was raised also by Dr Kashenga at the Dakawa Agricultural Research Station Institute, who argued that after three seasons of recycling a local variety cannot be considered true to that variety any longer. This is one of the reasons why Dakawa is collecting and characterising local maize and rice varieties, in order to maintain pure local lines for use in research programmes. Dr. Kishenga indicated that a portion of the Dakawa Institute's 100 ha of land could be used to multiply local seed varieties, a suggestion which was well received by farmer members of the research team.

The number of farmers involved or interested in QDS production indicates the potential for the development of seed producers in the area who, with the right support and training, could also multiply local varieties. This would be a long-term process as it would require access to sufficient land and possibly irrigation. The demonstration plots and the VBAA structure are well suited for adaptation to experimenting with farmer varieties so it is primarily a question of whether or not farmers are keen to work with local varieties. This would involve some discussion about quality controls, but these could be achieved through interactions between farmers and other stakeholders. Such interactions would be preferable to the external imposition of controls, as has been the case with current efforts regarding the regional harmonisation of seed trade and certification laws—which are inappropriate for farmer activities.

Consumption and processing

Farmers' preferences regarding the taste and aroma of local varieties cannot be underestimated. As mentioned above, local varieties more often than not are preferred by farmers, traders and consumers—they contain all the important factors (aroma and taste) and are also good for processing.

Rice is a preferred food in Tanzania and ranks as the third most important source of food, after maize and cassava. It is estimated that in 2010 at least 16 kg of rice was consumed per person (Wilson and Lewis, 2015). In order to meet the demand from rice consumers, whenever there is a shortage traders will mix a small portion of the local grain varieties with improved grain, so as to satisfy the partiality for the aroma. Occasionally farmers are forced to pool their rice quantity to meet the demand for local varieties.

With regard to the processing of rice varieties at the mill, traders prefer *Mbawa mbili*—it is in high demand, has good aroma and does not break during processing. However, millers can source only a few kilograms of the local varieties of rice from farmers, due to their low yields. Millers process at least 10–12 tons of rice and 4–5 tons of maize per day, during the harvesting season. Due to the lack of supply of local varieties such as *Mbawa mbili*, traders will accept Saro 5 as a next best choice. However, the millers will still pay TSh 275 more for local varieties, over improved varieties. Saro 5 is the most commonly milled grain by commercial millers in the area.

Conclusion and next steps

This research was the first step in a process to identify the variety of seeds farmers are using, whether these seeds are suitable for their needs, what sorts of improvements farmers desire, and to determine if farmers are interested to take this issue further, in partnership with ACB, MVIWATA and SAT. In the research sites, although there is a wide range of crops being grown, rice and maize are the dominant food crops and farmer varieties are by far the most widely used seed. This is partly because of the positive traits inherent in these varieties, especially aroma, taste and pest resistance/storability. However, apart from the two main crops, variety diversity is very low and this is of real concern. For example, millet is not being grown and is disappearing from the sites.

Although only an initial scan, our research suggests that FMSS provides a vital service to the majority of farmers in both areas, and also houses a wealth of genetic diversity and traditional knowledge. It is also clear that this diversity is diminishing, as a result of the adoption of modern varieties which, while having some advantages over local varieties, are highly dependent on the provision of public infrastructure and finance for external inputs. They also reveal some shortcomings in terms of their susceptibility to certain pests, both in the field and during post-harvest storage. These deficiencies must be viewed in tandem with the desire of farmers and processors to continue using local varieties, even if this is in conjunction with improved varieties, to cater to local preferences regarding taste, aroma and processing.

With regard to potential improvements to farmer varieties, the top priorities are higher yields and shorter maturation periods, while retaining the important positive traits of local varieties. Institutional arrangements for improvements are mostly in place. These include a functioning extension service, the VBAA structure and demonstration plots, and the Dakawa Agricultural Research Institute and Mkindo Training Centre who are available for technical support. The extension service,

Rice Nursery at Farmer Field School in Hembeti-Mvomero

MVIWATA and SAT function as civil society organisations. Although policy is oriented towards encouraging the development and use of certified seed varieties, there is interest amongst all these actors to work on farmer varieties in a participatory way.

Farmers and key informants who participated in the study were generally very positive about the opportunity for direct engagement with one another on a more regular basis. The importance of having sustained, long-term working relationships between farmers and their support organisations cannot be over-emphasised.

Farmers indicated a desire for more assistance from extension officers, specifically for farmer varieties, and also made explicit requests for increased training on plant disease management for vegetatively-propagated

crops, and for soil testing. Farmer exchanges for sharing location-specific knowledge on farmer varieties and wild plants was identified as an area of interest. Several calls were made for increased research into improving farmer varieties and for support to farmers who want to start multiplying local seed varieties.

The next steps will be to share the results of this research with the participants, and then discuss practical ways to take the work forward. These could include identification of specific individuals who are interested in experimenting with farmer varieties; identifying the specific varieties and enhancements/improvements they would like to make; facilitating discussions with farmers about how to ensure they retain control over any improved seed; discussions on local level quality standards with farmers and technicians; and engaging with technical support and extension services to see how such processes could be initiated. There will also be opportunities to explore other aspects of farmer seed systems in greater depth, together with farmers.

Despite their distance from the policy arena, in physical and metaphorical terms, many farmers recognised that the current policy environment is far from conducive to their agricultural activities. They have suggested that amendments be made to seed legislation to make these regulations more amenable to their everyday experience of farming, and also called for the diversion of subsidies, from hybrid maize and fertiliser, towards farmer varieties.

Appendix 1. Medicinal/wild relative crops recorded

MEDICINAL / WILD RELATIVE CROPS		
Name		**Uses and characteristics**
1	Aloe Vera	The sap of the Aloe Vera is used to treat skin diseases. The plant can be boiled and the drink produced is used to treat malaria. It is also used to make cosmetics and as a component in toothpaste.
2.	Cashew plant	Bark is used for toothache
3.	Cedrella Odorata	
4	Chunga	Seasonal, from November to May
5.	Delega	
6	Drumstick trees	Seeds are used to reduce high blood pressure
7	Euphorbia+Mango leaves+guave+pawpaw	These are used to treat diabetes
8	Gliricidia	
9	Guava tree leaves	
10	Hibiscus (Rosella)	Used to increase blood (hb) levels
11	Kidere	Resembles Delega
12	Kifulwe	
13	Lantana camara	
14	Lubi	Tasty with a strong odour
15	Lufwu la Ng'ombe	Yellow flowers and very tasty. It grows in high altitude areas.
16	Mambo leo	Seasonal, from June to October
17	Mango leaves	
18	Mbazi	
19	Mexican marigold	
20	Mjuwi	
21	Mkingu	
22	Mkungu	
23	Mkwambekwambe	
24	Mkwizingwi	Used to treat specific ailments—stomach ache, malaria and skin diseases.
25	Mlongelonge	The leaves are used to treat diabetes. A tea made from the leaves is given to livestock. The seeds are used to treat malaria, stomach flu and typhoid. As a treatment for malaria, the sufferer is advised to swallow at least 4 seeds (as tablets) three times a day.
26	Mnanaa	
27	Moringa	Moringa seeds are used for stomach pains. The sufferer chews the seeds and then drinks water to wash them down. The bark of the Moringa tree is used to treat haemorrhoids. It will be harvested, ground and wrapped in newspaper. The sufferer will then squat on it for a lengthy period of time. Moringa leaves are used to make juice and also as spices for vegetables.
28	Mpilili	
29	Msaji	
30	Msembesembe	

MEDICINAL / WILD RELATIVE CROPS		
Name		**Uses and characteristics**
31	Mstafeli	
32	Mwidu	
33	Neem (Mwarobaini)	The leaves and bark are used for the treatment of various ailments and fever.
34	Nung'anung'a	
35	Nyalugudi (Blackjack)	This is used to counteract dizziness. It is harvested, ground with a mortar, and the juice extracted is given to the sufferer to drink
36	Nyemba	
37	Nyonyo &Mturatura	Roots are used for toothache
38	Ocimum	
39	Pigeon pea leavess	
40	Teak tree	
41	Tephrosia	
42	Ukwaju	
43	Vernonia	Used to treat malaria
44	Vitunguja (small tomatoes)	
45	Vuzivuzi	
46	Wild Legumes	Roots are used to treat stomach ache
47	Wild Sunflower	

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