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Groundnut production constraints, farming systems, and farmer-preferred traits in Tanzania

Happy Daudi[a,b], Hussein Shimelis[a], Mark Laing[a], Patrick Okori[c], and Omari Mponda[b]

[a]African Centre for Crop Improvement, School of Agricultural, Earth and Environmental Sciences, College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Pietermaritzburg, South Africa; [b]Oil Seeds and Grain Legume Department, Naliendele Agricultural Research Institute, Mtwara, Tanzania; [c]International Crops Research Institute for the Semi-Arid Tropics, Lilongwe, Malawi

ABSTRACT

Groundnut (*Arachis hypogaea* L.) production in Tanzania is affected by a multitude of biotic and abiotic stresses and socioeconomic constraints. The objective of this study was to document the groundnut farmers' major production constraints, farming systems, and varietal trait preferences in selected agroecologies of Tanzania. A participatory rural appraisal study was conducted in three groundnut-producing zones: Lake, Central, and Southern. Data were collected from 170 groundnut farmers using a semistructured questionnaire, focus group discussions, and field observations. The production constraints were mainly diseases and pests, which were reported by 87.7% and 84.9% of respondents, respectively. Groundnut rust, caused by *Puccinia arachidis* Speg, was the major cause of yield reduction, as reported by 30% of the respondents. Drought stress and nonavailability of seed of improved varieties were other important constraints, as reported by 83.9% and 76.1% of the respondents, respectively. Groundnut agronomic attributes preferred by farmers were as follows: high yield (reported by 78.4% of respondents), disease resistance (71.2%), early maturity (66%), drought tolerance (63.0%), and pest resistance (63%). Medium-to-large grain size (reported by 62.6% of respondents) and tan and red seed color (59.2%) were the main farmer- and market-preferred groundnut seed quality traits. Groundnut variety development programs should therefore address the above constraints and farmer-preferred traits for sustainable groundnut production and productivity in Tanzania.

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Agronomic attributes; *Arachis hypogaea*; farmers' preferences; groundnut rust; participatory rural appraisal; PRA

Introduction

Groundnut (*Arachis hypogaea* L., AABB, $2n = 4x = 40$) is one of the world's important crops, ranking fifth in oil production after soybeans (*Glycine max* L.), cotton (*Gossypium hirsutum* L.), rapeseed (*Brassica napus* L.), and sunflower (*Helianthus annuus* L.). In addition, Rhizobia, in association with groundnut plant, fix atmospheric nitrogen into the soil, which improves soil fertility.

CONTACT Happy Daudi daudihappy@gmail.com African Centre for Crop Improvement, School of Agricultural, Earth and Environmental Sciences, College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Pietermaritzburg, South Africa

Groundnut seed is a rich food source providing quality vegetable oil (48–50%), protein (26–28%), dietary fiber, minerals, and vitamins (Pasupuleti et al. 2013). Globally, groundnut is grown in more than 100 countries situated in tropical, subtropical, and warm temperate regions (Upadhyaya et al. 2012). According to FAOSTAT (2015), Africa accounted for about 32% of the global groundnut production in 2015.

Shinyanga, Tabora, Dodoma, Mbeya, and Mtwara regions are the major groundnut production agroecologies in Tanzania (NBS 2012). Tanzania produced 5% of global production of groundnut in 2015, mainly under rain-fed conditions. According to Sibuga, Kafiriti, and Mwenda (1992), the crop is traditionally intercropped with cereals or cassava (*Manihot esculenta* Crantz). Farmers in Tanzania grow groundnut on flat seedbeds or on ridges. Yields of groundnut in Tanzania are reported to be 500 kg ha^{-1} to 1,000 kg ha^{-1} compared with 1,500 kg ha^{-1} to 2, 500 kg ha^{-1} reported in other African countries. For instance, in 2015, the mean groundnut yield (in shell) was 11,300 kg ha^{-1} in Tanzania, compared with 12,376 kg ha^{-1} reported in Nigeria and 11,536 kg ha^{-1} in Guinea-Bissau (FAOSTAT 2015). The lower yields in Tanzania have been attributed to unreliable rainfall, diseases and insects, low-yielding varieties and outdated agronomic practices (NARI 2010).

The most important biotic factors affecting groundnut production and productivity in the country include groundnut rosette disease (groundnut rosette assistor virus, groundnut rosette virus and a satellite RNA), rust (*Puccinia arachidis* Speg), early leaf spot (*Cercospora arachidicola* Hori), and late leaf spot (*Phaseoisariopsis personata* Berk. & Curtis) (Reddy et al. 2003). Use of improved groundnut cultivars and production technologies is essential for boosting crop yields. In-depth knowledge of farmers' preferences, production challenges, and priorities are prerequisites in production technology development (Ramadhani, Otsyina, and Franzel 2002).

In Tanzania, there is no recent study documenting groundnut production constraints and traits preferred by farmers. The study conducted by (Bucheyeki et al. 2010) in the Tabora region identified drought and low-yielding varieties as the most serious production problems. Participatory rural appraisal (PRA) is a multidisciplinary research approach that aims to incorporate knowledge and opinions of farmers in the planning and management of research development projects and programs. For instance, participatory breeding incorporates farmers' concerns and preferences during variety development, testing, and release (Ceccarelli and Grando 2007). This results in increased adoption of newly developed cultivars by farmers (Adu et al. 2004; Dorward et al. 2007). Various PRA techniques include key informant interviews, focus group discussions (FGDs), transect walks, matrix scoring, and ranking. These techniques are effective channels for improving interaction between researchers and farmers (Witcombe et al. 2006). In West Africa through farmer participatory selection, the International Crops Research Center for the Semi Arid Tropics and regional partners have developed diverse groundnut varieties with desirable attributes including varied maturity groups, resistant to groundnut rosette disease, foliar diseases, and agronomic traits (Ndjeunga et al. 2008). Yield increases attributable to the adoption of new cultivars of rice (*Oryza sativa* L.) resulting from participatory plant breeding programs have been reported in South and Southeast Asia (Witcombe, Parr, and Atlin 2002). Danial et al. (2007) reported that improved varieties of potato (*Solanum tuberosum* L.), barley (*Hordeum vulgare* L.), pearl millet (*Pennisetum glaucum* [L.] RBr.), and maize (*Zea mays* L.) were developed in an international project in three Andean countries using participatory varietal selection. Therefore, it is important to consider farmers' needs and preferences in groundnut cultivar development and selection to ensure adoption of improved cultivars by farmers. Therefore, the objective of this study was to identify the major constraints affecting groundnut production and farmer-preferred groundnut traits in Tanzania to guide future breeding programs.

Materials and methods

Description of study sites

The study was conducted in three regions: Mtwara (10.3539°S, 40.1682°E; Southern Zone), Dodoma (58.669′S, 35º, 46.093′E; Central Zone), and Shinyanga (3°39′43′′S, 33°25′23′′E; Lake Zone), which are the main groundnut production areas in Tanzania (Figure 1). The mean temperature in Mtwara ranges between 24.3°C in July and 27°C in December, with a mean annual rainfall of 820 to 1,245 mm. The site has an altitude of 135 meters above sea level (masl), with a rainfall pattern that is monomodal and erratic. A dry spell of 1–2 weeks often occurs at the end of January or at the beginning of February. Nanyumbu district was selected to represent this region.

Dodoma region was represented by the Bahi district, which has mean monthly temperatures varying between 15°C and 30°C. The area is located at an altitude of 1,080 masl, with an annual rainfall that is marked with large variations in amount and distribution, and it ranges between 300 and 800 mm, with a mean of 600 mm. The rainfall pattern is monomodal (December to April). A long dry season occurs between May and November.

Shinyanga region was represented by Ushetu district, which is located at 1,000 to 1,200 masl. The area is characterized by undulating plains with rocky hills, well-drained soils with low fertility and a growing season that runs from December to March. The site experiences mean temperatures ranging from 16°C in June to 33°C in October, with prolonged warm conditions.

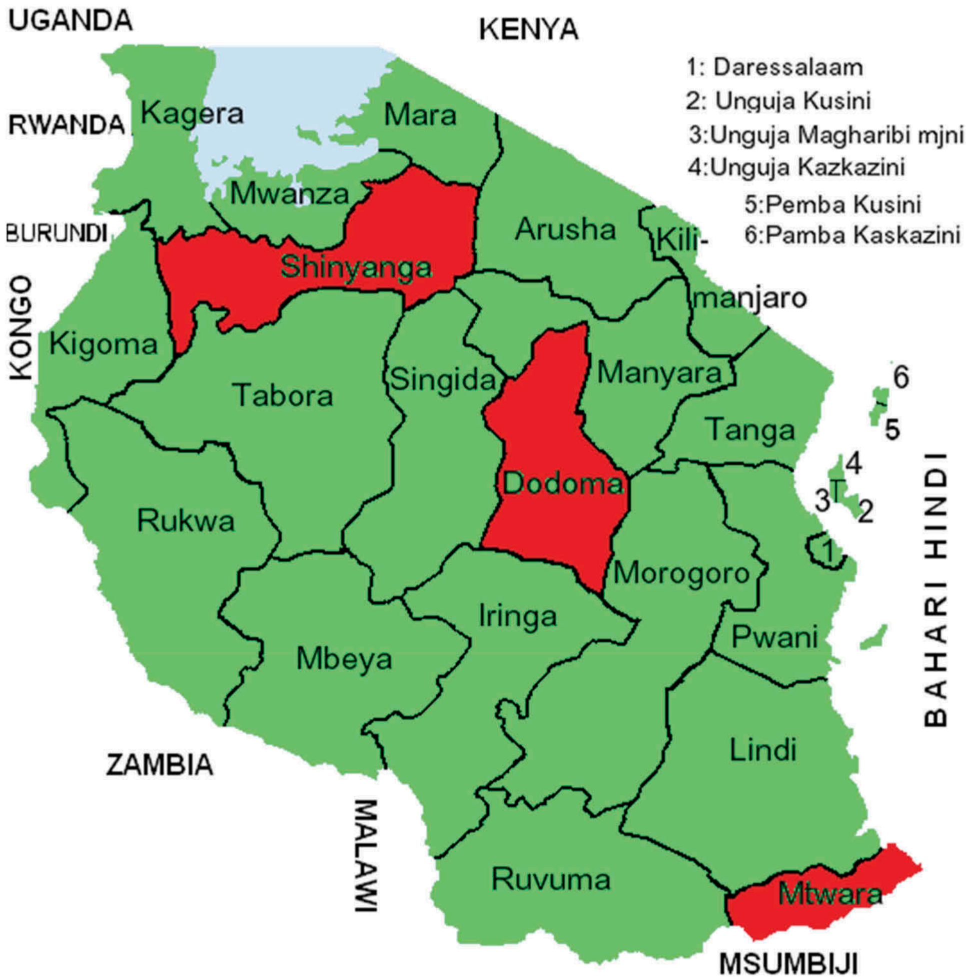

Figure 1. Map of Tanzania showing the study sites indicated in red shaded sectors.

Questionnaire design, sampling, and data collection

A semistructured questionnaire, transect walks, and FGDs were used to collect information from selected farmers. Data gathered from transect walks and FGDs were used to support and validate the information obtained from the semistructured questionnaire. In each district, two wards were subsampled, which were Mpunze and Sabasabini in the Ushetu district, Kigwe and Ilindi in the Bahi district, and Likokona and Kamundi in the Nanyumbu district. Each ward was represented by two villages that resulted in a total of 12 villages, which were Mpunze, Bulima, Sabasabini, Iponyanhoro, Kigwe, Mapinduzi, Ilindi, Mindola, Likokona, Msinyasi, Nawaje, and Nahimba. From each village, 10–15 farmers were selected with the assistance of agricultural extension officers and local leaders. In total, 170 farmers were interviewed using the semistructured questionnaire and FGDs. Through the semistructured questionnaire, the following data were gathered: household information, farm size, farming system used, constraints to groundnut production, important crop traits preferred by farmers, and market accessibility. Transect walk was done to make direct observations on a few randomly selected fields in each village. Other PRA tools used to gather information included problem listing and FGDs. In addition, farmers were queried about their understanding of groundnut rust disease and control measures they used. Farmers' preferred groundnut traits were described and ranked using a score of 1 (very important), 2 (intermediate importance), and 3 (least important).

Data analysis

Quantitative and qualitative social survey data collected were coded and analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 16 (SPSS 2007). Cross-tabulation tables were constructed, and descriptive statistics were generated to summarize data from the questionnaires and FGDs. To make statistical inferences, contingency Chi-square tests were conducted to analyze relationships between variables.

Results

Description of households

Table 1 contains a summary of the basic sociodemographic profile of the respondents. Out of the 170 smallholder farmers interviewed, 81 (48%) were females and 89 (52%) males, which suggested that there was gender balance in the study. The gap between number of males and females participating in

Table 1. Sociodemographic profiles of the farmers in the study areas.

		District						
Variable	Category	Bahi	Ushetu	Nanyumbu	Total	DF	Chi-square	*P* value
	Male	28	28	33	89	2	2.563	0.278
Gender	Female	32	28	21	81			
Age (years)	15 – 30	7	6	4	17	4	9.237	0.055
	31 – 60	41	45	48	134			
	≥61	12	5	2	19			
Education level	Nonformal	9	7	6	22	10	5.628	0.845
	Primary incomplete	10	5	6	21			
	Primary complete	37	36	38	111			
	Secondary incomplete	1	3	2	6			
	Secondary complete	2	3	2	7			
	Tertiary education	1	2	0	3			
Family size (number of individuals per family)	≤5	30	13	34	77	4	49.328	0.004
	6–9	30	34	20	84			
	≥10	0	9	0	9			

the study was bigger in Nanyumbu, with >60% males and <40% females. Ushetu had an equal number of male and female participants, and the proportion of females (53%) was greater than that of males (47%) in Bahi. Both male and female farmers produced groundnut as a cash crop, though females used it as their instant cash source by selling it in small quantities to meet the financial needs of their families, whereas males tended to sell the harvest in bulk in a single transaction.

Ten percent of the participants were under 30 years of age, 79% between 31 and 60 years, and 11% were >60 years of age. Farmers older than 60 years accounted for an average of 11% of the respondents. Most young people did not participate in the agricultural activities, as shown by a small percentage (10%) of respondents. Most respondents (65.3%) had attended primary school and were able to read and write the local language (Kiswahili). On the other hand, 4.1% and 1.8% respondents had obtained secondary and tertiary education; 12.4% and 3.5% of the respondents did not complete their primary and secondary education, respectively. The remainder 12.9% had not attended school at all (Table 1). The low level of education in the study areas necessitated the use of vernacular language by extension and research service providers or "change agents" in communicating the nature and value of any new technologies or agricultural inputs to these communities for their rapid adoption. The educated respondents (5.9%) can be useful agents in gathering information regarding farmers' constraints, needs, and priorities. They can also serve as facilitators when introducing new technologies of value to the smallholder farming communities in the study areas.

About 45.3% of the total households in the three districts comprised ≤5 people and only 5.3% of the households comprised more than 10 people. About half of the families (49%) had 6–10 individuals. The number of individuals per household influenced farming operations requiring human labor. Households with more than five family members were more efficient in groundnut farming than families with fewer members, which predominantly outsourced their labor needs from their communities or cultivated only a small portion of their land. Labor was one of the major constraints affecting groundnut production operations, such as land preparation, planting, weeding, harvesting, and shelling.

Role of male and female farmers in groundnut farming activities

Results from all study sites showed that both men and women participated equally in groundnut farming activities. This contradicted the findings by Katundu, Mhina, and Mbeiyererwa (2014), who reported that women were the major producers of groundnut in Tanzania. However, there were still some activities in which more women were involved than men, and vice versa. For instance, in threshing activity, females participated the most, whereas males were more involved in the selling activities in all the three districts (Table 2). In addition, females frequently engaged their children in farm activities, especially weeding, harvesting, and threshing.

Role of crop production in the study areas

In the study area, farmers depended on both crops and livestock as major sources of food and income. The area of land being cultivated by each interviewed individual farmer ranged from 0.1 to 8.8 ha. Crops grown in the study districts included groundnut, maize, cassava (*Manihot esculenta* Crantz), sesame (*Sesamum indicum* L.), rice (*Oryza sativa* L.), Bambara nut (*Vigna subterranea* Verdc.), cowpea (*Vigna unguiculata* [L.] Walp.), pigeonpea (*Cajanus cajan* L.), green gram (*Vigna radiata* [L.] Wilczek), cashew nut (*Anacardium occidentale* L.), sorghum (*Sorghum bicolor* L.), cotton (*Gossypium hirsutum* L.), common beans (*Phaseolus vulgaris* L.), sunflower (*Helianthus annuus* L.), watermelon (*Citrullus lanatus* L.), and sweet potato (*Ipomoea batatas* [L.] Lam.) (Figure 2). Of the total cultivated land, 9.7% was allocated to groundnut production and 8% to maize in the 2016/2017 cropping season. Some crops were grown in specific locations. For example, cashew nut was grown mostly in Nanyumbu district, occupying 14.7% of the total cultivated land. Furthermore, the amount of land allocated to sorghum in Bahi was almost equal to that of rice grown mostly in Ushetu (Figure 2). According to the farmers, most of the crops were grown during the rainy season, i.e. from December to April in Nanyumbu and Bahi and from October to February in Ushetu.

Groundnut production constraints

Production constraints faced by farmers in the three districts are summarized in Table 3. The major constraints included diseases, insect pests, drought, and nonavailability of improved varieties. In the FGDs, female farmers identified field insect pests as the major constraint, followed by foliar diseases; whereas male farmers identified drought as the main groundnut production constraint, followed by field insect pests and diseases. Farmers' ranking of production constraints across districts showed that 85.7 to 90.7% of the respondents felt that groundnut production was highly constrained by diseases. The main diseases reported were rosette (58.5%) and rust (30%) (Figure 3). Rust disease, reported mainly in Nanyumbu district (48.3%), was promoted by high temperature and humidity in this area. These findings were also observed during the transect walk in farmers' fields in Nanyumbu district (Figure 4). Mondal and Badigannavar (2015) reported that the development of rust epidemics was favored by continuous high temperatures (>22°C), along with wet weather or high humidity (>78%). A few farmers

Table 2. Percent participation by farmers in various groundnut farming and market activities in Bahi, Ushetu and Nanyumbu districts in Tanzania.

	Bahi							Ushetu							Nanyumbu						
Activity	M†	F‡	C§	MFC¶	MF#	MC††	FC‡‡	M	F	C	MFC	MF	MC	FC	M	F	C	MFC	MF	MC	FC
Land preparation	8.3	20	0	10	58.3	0	3.3	10.7	8.9	1.8	25	46.4	3.6	3.6	5.6	20.4	0	9.3	59.3	0	5.6
Planting	20	13.3	0	13.3	50	1.7	1.7	3.6	10.7	0	26.8	48.2	3.6	7.1	7.4	11.1	0	14.8	55.6	0	11.1
First weeding	5	12.5	0	25	51.7	1.7	5	3.6	7.1	0	37.5	42.9	0	8.9	1.9	11.1	0	13	50	0	11.1
Second weeding	8.3	10	0	21.7	48.3	0	6.7	9	35.4	0	32.1	39.3	0	10.7	1.9	3.7	0	3.7	44.4	0	3.7
Harvesting	3.3	11.7	0	26.7	51.7	1.7	5	3.6	3.6	0	33.9	48.2	0	10.7	3.7	13	0	27.8	46.3	0	9.3
Drying	6.7	28.3	0	13.3	48.3	0	3.3	7.1	12.5	0	30.4	42.9	0	7.1	3.7	11.1	0	25.9	46.3	0	13
Threshing	11.7	30	0	13.3	23.3	1.7	11.7	3.6	17.9	0	23.2	10.7	0	19.6	3.7	11.1	5.6	29.6	22.2	0	9.3
Selling	37	25	1.7	0	35	0	0	42.9	14.3	0	1.8	41.1	0	0	35.2	22.2	0	0	42.6	0	0

†M = Male.
‡F = Female.
§C = Children.
MFC = Male, female, and children.
#MF = Male and female.
††MC = Male and children
‡‡FC = Female and children.

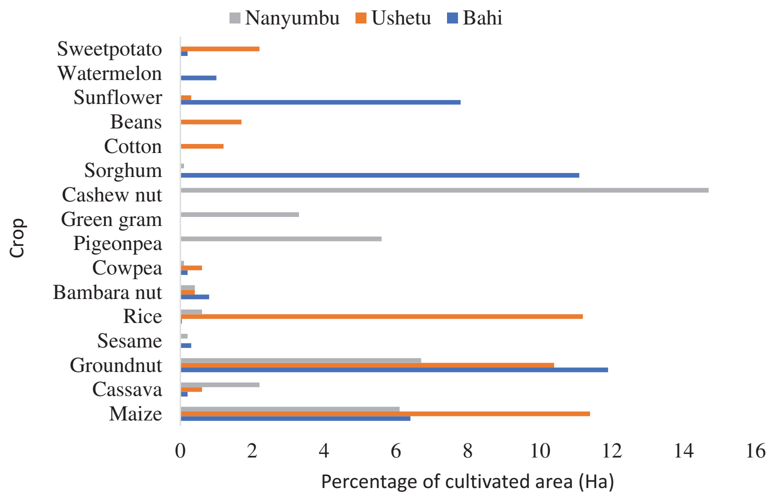

Figure 2. Different crops grown in 2016/2017 cropping season in three selected districts in Tanzania.

mentioned the removal of infected plants from their fields as one of the mitigation strategies against groundnut rosette disease. The ranking of diseases as production constraints did not show significant differences (χ^2 = 3.318; P = 0.506) among the districts.

Apart from the diseases, the second most yield-limiting factor in the study areas was field pests (Table 3). Groundnut hopper (*Hilda patruelis* Stal.) was one of the insect pests that affected groundnut production, followed by white grub (*Holotrichia consanguinea* Blanch.) and aphids (*Aphis craccivora* Koch.). Drought was ranked the third most yield-limiting factor for groundnut production in the study areas (Table 3). Severe droughts were reported by 74.1% to 89.3% of the respondents across all studied districts during the study period. Drought is associated with frequent fluctuations in the general atmospheric circulation in almost all parts of Tanzania. To mitigate drought stress, farmers adopted various strategies, such as mixed crop-livestock farming and early planting. In addition, drought was associated with rosette disease and aphid infestations.

Groundnut varieties grown in the study areas

The names of groundnut cultivars grown in the three districts were recorded using their local names (see Table 4). Improved varieties like Pendo and Mnanje were grown in the study areas by a few farmers. Different landraces were reported to be cultivated in each district, and most of them were maintained by farmers. In each district, the landraces were different because of several specific traits, such as adaptability to environmental stresses, drought tolerance, a high market value, seed availability, and the ability to adapt to different climatic

Table 3. Percentage of farmers and reported groundnut production constraints in Bahi, Ushetu, and Nanyumbu districts in Tanzania.

		District						
Constraints	Importance	Bahi	Ushetu	Nanyumbu	Mean	DF	Chi-Square	*P* value
Limited land availability	Very important	28.6	7.3	9.3	15.1	4	13.8	0.008
	Intermediate	16	10.9	22.2	16.4			
	Less important	60.7	81.8	68.5	70.3			
Poor soil fertility	Very important	45	56.4	31.5	44.3	4	8.055	0.090
	Intermediate	26.7	27.3	33.3	29.1			
	Less important	28.3	16.4	35.2	26.6			
Low-yielding varieties	Very important	74.6	60.7	50	61.8	4	10.280	0.036
	Intermediate	8.5	5.6	5.6	6.6			
	Less important	17	34	44.4	31.8			
Unavailability of improved varieties	Very important	83.3	84	61.1	76.1	4	16.451	0.002
	Intermediate	10	7.1	7.4	8.2			
	Less important	6.7	8.9	31.5	15.7			
High cost of seeds	Very important	63.3	61.8	85.2	70.1	4	9.197	0.056
	Intermediate	6.1	9.1	3.7	6.3			
	Less important	30.6	29.1	11.1	23.6			
Poor supply of seeds	Very important	69.5	80.4	54.7	68.2	6	12.849	0.045
	Intermediate	11.9	3.6	9.4	8.3			
	Less important	17	16.1	35.8	23			
Drought	Very important	88.3	89.3	74.1	83.9	4	13.705	0.008
	Intermediate	10	8.9	9.3	9.4			
	Less important	1.7	1.8	16.7	6.7			
Field insects	Very important	88.3	88.9	77.4	84.9	4	20.311	0.000
	Intermediate	10	8.9	5.7	8.2			
	Less important	1.7	32.1	17	16.9			
Storage pests	Very important	57.6	44.6	37.7	46.6	4	9.421	0.051
	Intermediate	11.9	3.6	7.5	7.7			
	Less important	30.5	51.8	54.7	45.7			
High cost of pesticides	Very important	38.6	44.6	44.9	42.7	4	11.103	0.025
	Intermediate	24.6	33.6	10.2	22.8			
	Less important	36.9	21.4	44.9	34.4			
Diseases	Very important	86.7	85.7	90.7	87.7	4	3.318	0.506
	Intermediate	10	5.4	5.6	7			
	Less important	3.3	8.9	3.7	5.3			

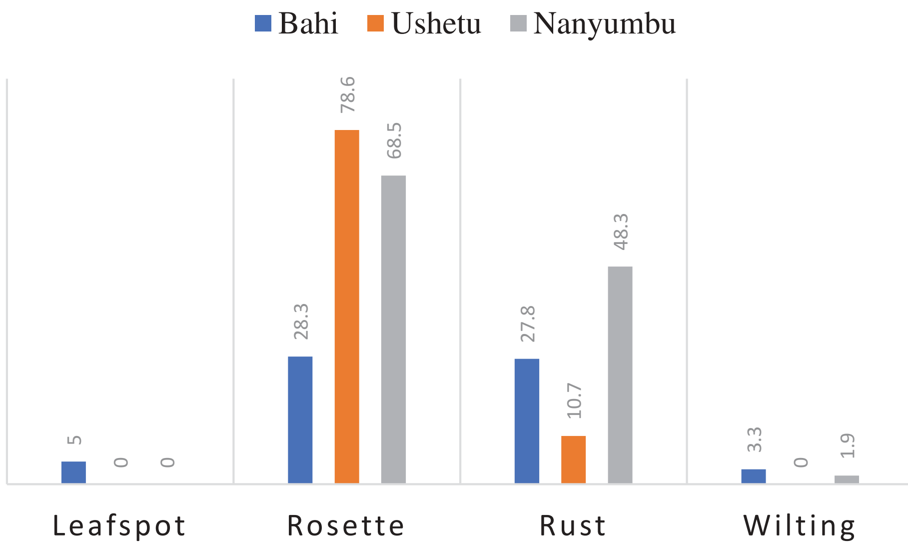

Figure 3. Percentage of respondents that reported the main groundnut diseases in the study areas.

Figure 4. Groundnut rust in one of the farmer fields in the Nanyumbu district.

conditions. Bucheyeki et al. (2008) reported on the adoption of the Pendo variety by farmers in the Tabora region, which was selected for its high yields, and Mamboleo, which was selected for its yield stability. Farmers indicated that Pendo, released in 1998 by Naliendele Agricultural Research Institute (NARI), was susceptible to diseases and insect pests. Mnanje 2009, also released by NARI, was reported to have poor germination and a high level of susceptibility to diseases.

Farmer-preferred traits

Farmers in the study areas selected groundnut cultivars for production on the basis of yield, maturity, grain color, grain size, drought tolerance, insect pest resistance, disease resistance, good market price, taste, and oil content (Table 5). In addition, women considered taste to be an important trait, especially for

Table 4. Groundnut varieties grown in the Bahi, Ushetu, and Nanyumbu districts in Tanzania, and their associated characteristics.

		Suggested traits	
Districts	Names of varieties	Preferred	Nonpreferred
Bahi	Mamboleo	Early maturity and drought tolerance	Susceptible to diseases and insect, low oil content, and in high rainfall restart to germinate
	Pendo	Early maturity, drought tolerance, high yielding, and sweet	Susceptible to diseases and insect
Ushetu	Red small	Marketable, early maturity, red in color, and high oil content	Susceptible to diseases and insect
	Malumbalala	Early maturity and high yielding	Difficult to harvest and low oil content
	Mnanje	High oil content, red in color, and sweet	Poor germination
	Pendo	Soft pod and high oil content	Low market price and susceptible to diseases and insect
Nanyumbu	Pendo	Early maturity, high yielding	Susceptible to diseases and insect and if delay to harvest can restart to germinate
	Johari	High yielding	Susceptible to diseases and insect
	Karanga Njugu	Hard pod cannot regerminate	Susceptible to diseases
	Mnanje	High yielding	Poor germination and late maturity

Table 5. Farmer-preferred traits (% farmers) in groundnut varieties in Bahi, Ushetu and Nanyumbu districts in Tanzania.

	District			
Trait	Bahi	Ushetu	Nanyumbu	Mean
Yield potential	71.2	75	88.9	78.4
Maturity	63.3	67.9	66.7	66
Grain color	45	71.4	61.1	59.2
Grain size	55	67.9	64.8	62.6
Drought tolerance	70	76.8	64.8	63.0
Insect pest resistance	60	66.1	63	63.0
Disease resistance	68.3	69.6	70.4	71.2
Good market price	65	66.1	64.8	62.3
Taste	58.3	66.1	55.6	60
Oil content	16.7	3.6	7.4	9.2

making groundnut butter, which is used as an ingredient in preparing foods. Farmers in Bahi considered oil content to be an important trait because they usually received low market prices for varieties with low oil content.

Farmers preferred early-maturing varieties, which could escape drought and diseases. Some varieties had distinct, market-preferred traits, such as grain color, which varied across markets. For instance, in Bahi and Nanyumbu, tan color was preferred, whereas farmers in Ushetu preferred a red color. Large size of groundnut seed and resistance to diseases were some of the other traits preferred by farmers in the study areas.

Farmers' knowledge of groundnut diseases and management options

About 86.7% of farmers had knowledge about groundnut rust, whereas 11.3% had no knowledge about rust (Table 6). Common symptoms for groundnut rust disease mentioned by farmers included yellow and brown leaf color. However, it was noted that most interviewed farmers confused the rust disease with other foliar diseases, such as leaf spot. About 82% of the respondents did not know how the rust disease spread. Only a limited number of the respondents knew that rust was spread by wind and that the primary inoculum could arise from volunteer plants. All respondents described that they did not know how to control the rust disease, and all varieties cultivated were susceptible to the disease. This suggests that farmers' training is important, especially regarding rust control. Furthermore, it indicated the need for developing groundnut varieties with resistance to rust, in addition to other farmer-preferred traits, such as improved yield, early maturity, tolerance to drought stress, and medium grain size.

Discussion

PRA is an important tool to learn from rural farming communities (Chambers 1994) . In the present study, both male and female farmers were well-represented (Table 1), which reflected gender equality in groundnut production and planning for their community development (Table 1). In smallholder farming communities, the household is the major source of labor (Mendola 2007). Therefore, the larger the household size, the greater the labor force available, and, in turn, the larger the area of land cultivated. Households with only two members (wife and husband) or three members had limited labor, and therefore, they usually cultivated areas of less than one hectare. Households of four or more members cultivated areas of more than 2 ha. The study also showed that most active farmers were between 30 and 60 years of age in all districts (Table 1). This was because people of less than 30 years of age had other jobs in nearby towns or they were selling goods, such as cold drinks and clothes in the villages.

Table 6. Perception of farmers about groundnut rust in the study areas.

		District						
Variable	Response	Bahi	Ushetu	Nanyumbu	Mean	DF	Chi-Square	*P* value
Knowledge of groundnut rust	Yes	98.3	71.4	96.3	86.7	2	25.572	0.000
	No	1.7	28.6	3.7	11.3			
Rust spread	Do not know	76.7	89.3	83.3	82.1	6	73.957	0.000
	Volunteer	0	3.6	3.7	2.4			
	Wind	23.3	7.1	11.1	13.8			
	Soil	0	0	1.9	0.6			

Groundnut was grown for food and cash. Other crops, such as cassava, maize, sorghum, and cowpea, were grown specifically for food security and watermelon, sunflower, and cashew nut were grown for cash. Farmers used groundnut as a source of cooking oil or snacks (roasted or boiled groundnuts).

Most of the farmers in the study areas preferred groundnut cultivars that were characterized by high yield, early maturity, red and tan grain color, medium-to-large grain size, drought tolerance, insect pest resistance, disease resistance, good market prices, taste, and oil content. Kitch et al. (1998) reported that farmer-preferred cultivars had large red seed.

The results from this study indicated that most of the farmers were aware of the constraints affecting their crops. Constraints, such as diseases, insect pests, drought, and nonavailability of improved cultivars, were reported to be the primary limiting factors in groundnut production in the study areas (Table 3). Groundnut rust was among the main diseases reported by farmers in the study areas. Respondents related rust symptoms to crop maturity since the disease appeared late in the season when the crop was about to mature.

This study-initiated dialog between groundnut farmers and groundnut researchers helped understand the main constraints to groundnut production encountered by farmers in the Lake, Central, and Southern zones of Tanzania. This dialog, through the participatory approach, confirmed that farmers were aware of the various issues affecting their daily lives, including crop production. According to Biggs (1978), farmers possess valuable knowledge and they can contribute to agricultural research and development and education.

During this study, farmers' participation in research activities occurring in their districts was somewhat low, which had led to a low rate of adoption of new technologies. The farmers continued to grow their local varieties, resulting in low yields. Farmer participation in agricultural research and development is important because it empowers them (Sperling, Loevinsohn, and Ntabomvura 1993) and increases the efficiency of the research by orienting it to their needs (Witcombe et al. 2006). Biggs (1989) proposed that farmers should be consulted to diagnose problems and influence research objectives, thus making them active partners in the research.

Conclusion

Groundnut is a food security crop and a source of income for rural households in sub-Saharan Africa. However, its productivity in the region is relatively low. Diseases, pests, drought, and nonavailability of improved seeds were identified as the main production constraints. Farmers in the study areas depended on agricultural activities, such as livestock rearing and growing a range of crops, in addition to groundnut, for food and income generation. Groundnut traits preferred by farmers were high yield, resistance to diseases and pests, early maturity, and drought tolerance. Medium grain size, high oil content, and tan or red seed color were the quality traits preferred by the famers and the market. Researchers could use the identified farmer-preferred traits as selection criteria in their groundnut breeding program to enhance groundnut production in Tanzania.

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Disclosure statement

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