Comparative advantage of newly-released varieties of groundnut in Tanzania

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Summary

Yields of groundnut in Tanzania are reported to be 2.5 to 3 times lower than other African countries. Use of obsolete varieties, unreliable rains, disease and insect pests' infestation and poor agronomic practices are some of the causes. To address these issues and to contribute to better nutrition and increased incomes of 14 million people dependent on groundnut cultivation, 11 improved groundnut cultivars were developed and released. The new varieties are high-yielding, drought-tolerant, rosette-tolerant and have market-preferred traits. This policy brief shows the comparative advantage of the new varieties over the old, both on and off-farm, and provides recommendations for increased yields, varietal uptake and market linkage.

Figure 1. Major regions of groundnut production in Tanzania.

1. Introduction

The major groundnut production regions in Tanzania are Mtwara, Songwe, Dodoma, Shinyanga, Geita, Singida, Kigoma and Tabora. Groundnut has direct and indirect positive impacts on the livelihood of about 14 million people in these regions and the country as a whole (NBS, 2018). However, yields of groundnut in Tanzania are reported to be low, standing between 500 kg/ha to 1,000 kg/ha compared with 1,500 kg/ha to 2,500 kg/ha reported in other African countries. For instance, in 2018, the mean groundnut yield (in the shell) was 984kg/ha in Tanzania, compared to 2,500 kg/ha reported in Algeria and 2,400 kg/ha in Kenya (FAOSTAT, 2018). Among other factors influencing groundnut productivity, the limited use of improved varieties by farmers was reported as one of the major bottlenecks to realize high yield in the country (Daudi et al. 2018; Akpo et al. 2020). This policy brief highlights the comparative advantage of newly-released groundnut varieties over the old ones and their importance in enhancing the commodity value chain performance in Tanzania.

2. Importance of improved varieties in groundnut farming systems

A key ingredient to increased productivity and production is farmer access to inputs, particularly quality seed of superior varieties. The lower yields in Tanzania have been attributed to unreliable rainfall, diseases and insects and obsolete varieties. The use of improved groundnut cultivars and other allied technologies are essential for **sustained increase in crop yields** against climate uncertainties, pests, and diseases.

Groundnut is **nutritious** and rich in energy, providing 567 calories per 100g. According to the United States Department of Agriculture (USDA, 2018), groundnut contains 40-50% fat, 20-50% protein, and 10-20% carbohydrates and minerals.

In addition to nutritional value of the grain, the groundnut crop **improves soil fertility** by fixing atmospheric nitrogen in the root nodules and thereby increasing the productivity of other crops when used in rotation or in intercropping.

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The growing demand in both the domestic and export markets could also provide a **source of income** for smallholder farmers to improve their productivity by growing the recently-released high-yielding varieties.

3. Existing demand, market traits, and opportunities in the groundnut value chain

The Western and Lake zones of Tanzania share similar grain preferences. The shared choice traits include medium tan (Naliendele 2009 and Mangaka 2009), red large (Masasi 2009) and large tan (Nachi 2015). These regions are the top groundnut producers, and it is estimated that about 150,000 tons were produced in the 2017 farming season and approximately more than 7,000 tons were exported by interviewed offtakers to Rwanda, Burundi, Kenya and Uganda. In the Central and Southern zones, the preferred varieties are Mangaka 2009 and Naliendele 2009, it was estimated that about 5,000 tons of groundnut were exported to Asian countries in 2017. In the Southern Highlands (Songwe and Katavi regions), the preferred traits were medium tan and red large grain (Nachi 2015, Mnanje 2009, Masasi 2009 and Naliendele 2016). Among, other commercial uses, more than 1,500 tons were exported by interviewed offtakers from these regions to Angola, Democratic Republic of Congo and South Sudan (Table 1). Eastern and Northern zones are not major groundnut producers, however, it is estimated that approximately 1,000 tons are annually exported to Asian countries, Kenya Uganda and South Sudan. These regions are also consuming grain produced from Southern Highlands and Central zones and also receive imported grain from Malawi.

Figure 2. Improved varieties of groundnut in Tanzania.

Photo: Daudi H and Alex G 2020

Table 1.Grain market traits demanded					
Zones	Local market	Preference	Export market	Tons	Varieties
Southern	Mtwara, Lindi	Medium tan, red large	India, Malaysia, Comoros	2,000	Mnanje 2009 or Masasi 2009
Central	Dodoma, Singida	Medium tan, red large	India, Malaysia, Comoros	3,000	Mnanje 2009 or Masasi 2009
Southern Highlands	Mbeya, Iringa, Njombe, Songwe, Rukwa, Katavi, Ruvuma	Tan, red large	Angola, DRC-Congo, South Sudan	1,500	Nachi 2015, Mnanje 2009, Masasi 2009, Naliendele 2016
Eastern	Dar-es-Salam, Morogoro, Coast	Medium tan, red large	India, Malaysia, Comoros	500	Mangaka 2009, Naliendele 2009, Mnanje 2009, Masasi 2009
Northern	Arusha, Kilimanjaro, Manyara	Medium tan, red large	Kenya, Uganda, Sudan	500	Mangaka 2009, Naliendele 2009, Mnanje 2009, Masasi 2009
Lake	Kagera, Geita, Shinyanga	Medium tan, red large	Rwanda, Burundi, Kenya, Uganda	4,000	Mangaka 2009, Naliendele 2009, Mnanje 2009, Masasi 2009
Western	Tabora, Kigoma	Medium tan, red large	Rwanda, Burundi, Kenya, Uganda	3,000	Mangaka 2009, Naliendele 2009, Mnanje 2009, Masasi 2009

4. Agronomic characteristics of improved groundnut varieties compared to the old

Improved varieties of groundnut in Tanzania can be categorized as old varieties and recently-released varieties. Old varieties are the ones released over 15 years and included Dodoma bold (released in the 1960s), Red mwitunde (released in 1976), Nyota (released in 1983), Johari (released in 1985), Sawia (released in 1998), and Pendo (released in 1998) (Table 2). These varieties were adopted by large numbers of farmers due to their yields between 0.6-1.5 tons/ha, and maturing dates between 90-120 days (Table 2). Although some of the old varieties have competitive traits, their susceptibility to the rosette virus disease, early and late leaf spots, sprouting at maturity if harvesting is delayed and absence of seed dormancy were major limitations. Knowing these, continuous efforts have been made to improve old varieties and replace them with new improved varieties suited to new threats and ever-changing agro-climatic conditions. These efforts led to 11 varieties released recently that are high-yielding, drought-tolerant, rosette-tolerant and suitable for confectionery. Varieties like Naliendele 2009 (90-100 days) and Mangaka 2009 (100-110 days) are early-maturing; medium maturity varieties are Narinut 2015 (110-115 days), Mtwaranut 2016 (110-115 days), Tanzanut 2016 (110-115 days), Mnanje 2009 (110-120 days), Nachigwea 2009 (110-120 days), Masasi 2009 (110-120 days), Kuchele 2015 (110-120 days), Naliendele 2016 (110-115 days), and Nachi 2015 (110-115 days) (Table 2). The recently released varieties are well-adapted to a wide range of agro-ecological zones with altitude 0-1,500 meters above sea level, rainfall 750-1,200 mm and light, fertile, well-drained soils, including low-rainfall regions (TARI, 2019).

Generally, after ten years from the year of release of a new variety, the particular variety needs to be replaced by the most recently released ones. The proposed replacement plan with the newly released varieties depends on the agro-ecological fitness and farmer preferences. For example, it is recommended to replace Pendo 1998 by Mangaka 2009 and Naliendele 2009, suitable for Southern and Central zones and some areas in Lake Zone. Similarly, Mnanje 2009 can be replaced by Naliendele 2016, and Nachigwea 2009 by Nachi 2015 varieties, both varieties are suitable for the Southern Highlands.

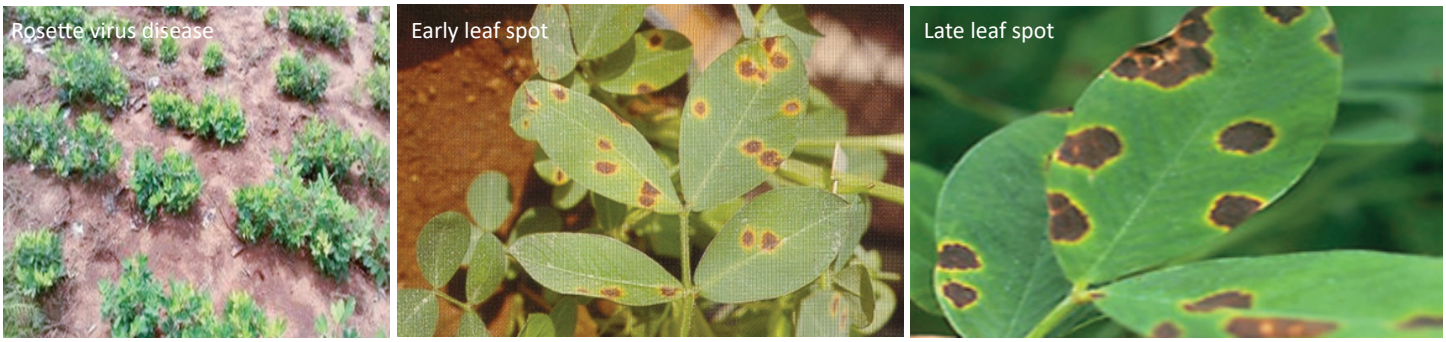

Figure 3. Groundnut diseases in Tanzania.

Photo: Daudi H and Alex G 2020

5. Genetic superiorities and yield advantage of recently-released groundnut varieties

Based on past experiences, it was learned that the adoption of new technologies is dependent on farmer preferences in conjunction with grain market demand and availability. Keeping this in mind, recently-released varieties incorporated market and farmer preferences such as color, size, micronutrients and oil content. Improved varieties are available in different color and size traits in line with farmer preferences. Just like tan and red colors, the size of the kernel ranges from medium to large size (Table 2). Kernels of groundnut contain a considerable amount of fat, protein, carbohydrates, and minerals (niacin, falacin, calcium, phosphorus, magnesium, zinc, iron, riboflavin, thiamine, and potassium) useful for human body development (Daudi et al. 2018). Some of the recently-released varieties have individual peculiar traits to meet farmers and market expectations. For example, three varieties were purposively developed, primarily for use in the confectionery market: Narinut 2015, Kuchele 2015 and Nachi 2015 (Table 2). Other varieties like Mnanje 2009, Mangaka 2009 and Naliendele

Table 2. Comparative advantage of new varieties over old ones.

Old varieties					Recent varieties				
Variety names	Year of released	Variety traits	Optimum yield (tons/ha)	Target agro-ecology	Variety names	Year of released	Variety traits	Optimum yield (ton/ha)	Target agro-ecology
Dodoma bold	1960s	Early maturity 90-100 days, tan, small size, 2-3 kernels/pod	0.6-1.0	Low to medium altitude	Masasi 2009	2009	Medium maturity 110-120 days, resistant to rosette disease, large size, red	1.0-1.5	Medium to high altitude
Red mwitunde	1976	Medium maturity 110-120 days, small size, red, 2-3 kernels/pod	0.6-1.0	Medium to high altitude	Nachigwea 2009	2009	Medium maturity 110-120 days, resistant to rosette, large size, tan	1.0-1.5	Medium to high altitude
Nyota 1983	1983	Early maturity 90-100 days, tan, small kernels.	0.8-1.5	Low to medium altitude	Mnanje 2009	2009	Medium maturity 110-120 days, susceptible to foliar diseases, large size, sweet, red	1.5-2.0	Medium to high altitude
Johari 1985	1985	Medium maturity 110-120 days, medium size, tan kernels	0.85-1.2	Medium to high altitude	Naliendele 2009	2009	Early maturity 90-100 days, drought tolerant, tan	1.5-2.0	Low to medium altitude
Sawia 1998	1998	Early maturity 100-110 days, tan, small kernels	0.95-1.1	Low to medium altitude	Mangaka 2009	2009	Early maturity 100-110 days, 2-3 kernels/pod, tan	1.5-2.0	Low to medium altitude.
Pendo 1998	1998	Early maturity 90-100 days, sweet, medium size, tan, susceptible to foliar diseases	1.1-1.5	Low to medium altitude	Nachi 2015	2015	Medium maturity 110-115 days, tolerant to rosette, tan, large size, confectionery	1.0-1.5	Medium to high altitude.
					Kuchele 2015	2015	Medium maturity 110-120 days, large size, tan, resistant to rosette, confectionery	1.0-1.5	Medium to high altitude
					Narinut 2015	2015	Medium maturity 110-115 days, large size, tan, resistant to rosette, confectionery	1.0-1.5	Medium to high altitude
					Naliendele 2016	2018	Medium maturity 110-115 days, tolerant to rosette, red, medium size pod	1.0-1.5	Medium to high altitude
					Tanzanut 2016	2018	Medium maturity 110-115 days, resistant to rosette, tan, large in size	1.0-1.5	Medium to high altitude
					Mtwaranut 2016	2018	Medium maturity 110-115 days, resistant to rosette, tan, large in size	1.0-1.5	Medium to high altitude

2009 have relatively higher oil content (51.5%w/w), zinc (94.5%w/w) and protein (34.5%w/w) respectively compared to others (Table 3).

The average yields of improved varieties range between 1-2 tons hectare^{-1} (Table 2). The yield performance of a specific improved variety is dependent on adherence to the recommended agronomic practices like seed rate, time of planting, plot weeding, etc. On average, farmers in Tanzanian plant 55 kg of seed per hectare, which is very low compared to the recommended agronomic practices of 80-100 kg/ha (TARI, 2011). Farmers are being discouraged of using grain as seed or recycling seed from one season to another as it lacks genetic purity and vigor that are required to support optimum yield and crop production.

Table 3. Nutrition profiling of improved groundnut varieties.

Varieties	Oils (%w/w)	Protein% (w/w)	Iron (Mg/Kg)	Zinc (Mg/Kg)
Pendo 1998	44.50	32.30	41.10	82.00
Mnanje 2009	51.50	29.50	65.40	35.30
Naliendele 2009	40.10	34.50	50.70	84.10
Mangaka 2009	41.10	32.90	47.80	94.50
Masasi 2009	46.70	25.40	20.60	23.10
Nachigwea 2009	44.50	31.30	23.40	77.50
Nachi 2015	43.70	32.40	33.90	66.00
Narinut 2015	46.20	24.20	20.50	25.20

Source: TFDA, 2018;
W/W: Weight by Weight, Mg: Milligram

4. Cost-benefit analysis of recently-released groundnut varieties

The cost-benefit (CB) analysis, which is also known as the profitability index, measures the rate of return on investment (ROI). It gives the amount of profit of every Tanzanian Shilling (TZS) invested in a project. It weighs the sum of the benefit, such as financial gains of an activity against the negatives, or costs, of that activity. It is expressed as a cost-benefit ratio which benefits divided by variable costs. The below analysis are from selected seed farmers growing recently-released varieties across the groundnut production regions (Table 4). All evaluated varieties had the value of CB ratio above one, the highest CB ratio (1.7) was from Kuchele 2015, Nachi 2015 and Mtwaranut 2016 varieties. The lowest CB ratio (1.1) was from the Naliendele 2009 variety. Although the cost-benefit analysis values indicated that seed farming is a worthy business to invest in, there is still room for improving yield performance by seed producers. For example, yield performance of six varieties was below 50% of their optimum yield standards; Masasi 2009 (45%), Tanzanut 2016 (48%), Naliendele 2016 (49%), Narinut 2015 (41%) and both Kuchele 2015 and Nachi 2015 had 41%. Improving farm management through adherence to the recommended agronomic practices could enhance optimum yield. The influence of output price on the total revenue is of great importance. Currently, the price of seed (shelled) under farmer's conditions is TZS 3,000/kg. Farmers' sensitization and education on the importance of improved varieties in the farming system could likely result in the price and profitability index increase.

5. Feedback from various value chain actors on preferences of recently-released groundnut varieties

Farmer's feedback was based on preferences and challenges encountered during the process of production and marketing of improved varieties. It was observed on a sample of 300 groundnut farmers that the most preferable and motivating traits considered by farmers

Table 4. Cost-benefit analysis of recently released groundnut varieties.

Varieties	Total Cost (TZS/ha)	Output (Kg)	Optimum yield (Kg)	% to Optimum yield	Revenue (TZS/ ha)	Benefit-Cost ratio	Benefit (TZS/ha)
Masasi 2009	1,095,955	726	1,600	45	2,541,000	1.3	1,445,045
Naliendele 2009	1,337,500	798	1,100	72	2,793,000	1.1	1,455,500
Tanzanut 2016	1,063,000	725	1,500	48	2,537,500	1.4	1,474,500
Naliendele 2016	1,081,750	725	1,500	49	2,537,500	1.5	1,518,750
Mangaka 2009	1,085,835	753	1,500	50	2,633,750	1.4	1,547,915
Nachingwea 2009	1,102,500	765	1,250	61	2,677,500	1.4	1,575,000
Narinut 2015	1,277,500	822	2,000	41	2,877,000	1.3	1,599,500
Mnanje 2009	1,097,918	775	1,500	52	2,712,500	1.5	1,614,582
Mtwaranut 2016	1,075,000	820	1,300	63	2,870,000	1.7	1,795,000
Kuchele 2015	1,089,168	825	2,000	41	2,887,500	1.7	1,798,332
Nachi 2015	1,078,750	830	2,000	41	2,905,000	1.7	1,826,250

when selecting the improved varieties were high yield (53%), drought tolerance (23%) and market preferences (16%) (Figure 2). The major challenges reported were pests and diseases (32%), high seed cost (24%), limited seed and knowledge of agronomic practices (24%) and susceptibility to prolonged drought (20%) (Figure 1). The offtakers were not facilitating access to improved varieties to the farmers. However, they were knowledgeable of various preferences of their end-users. For example, 40% of the 123 interviewed offtakers were able to identify the size and color that their end-users preferred.

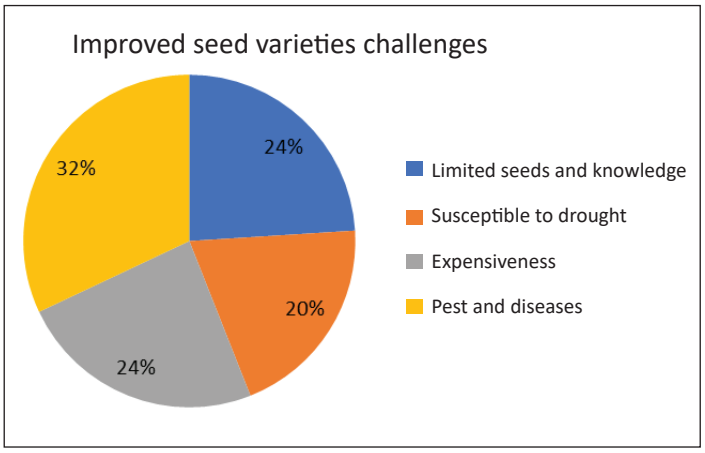

Figure 4. Challenges encountered by interviewed farmers cultivating the improved seed.

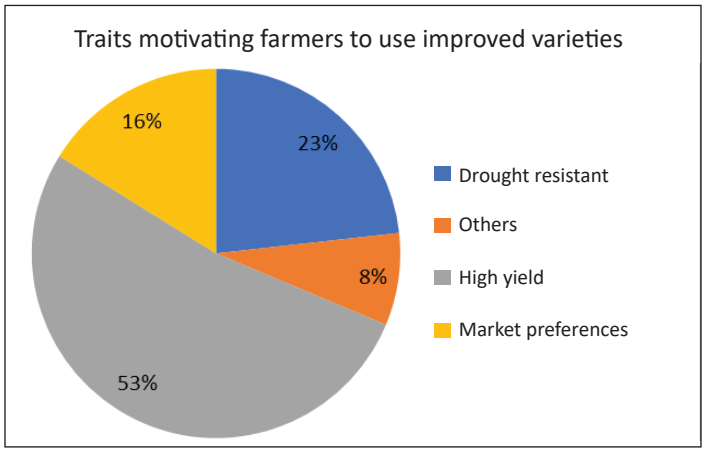

Figure 5. Traits motivating farmers to grow groundnuts.

7. Policy recommendations for the seed sector development in Tanzania

We derived the following policy recommendations based on the facts reported above.

- Enhance farmers' skills on best agronomic practices: This would go in hand with its allied technologies, i.e., appropriate seed rate, variety choice based on agro-ecology, planting date, spacing and other good agricultural practices to ensure that optimum yield is attained. Good agronomic practices play a major role in the overall crop productivity.
- Increase awareness creation activities: Increasing the use of demonstration plots, farmer field days, seed fairs and mass media communication are good avenues to increase awareness on improved varieties amongst farmers and and other value chain actors including grain offtakers. Farmer awareness on new and high productive varieties is key to their variety choice decision. Unless farmers know of the variety, they will not appreciate the genetic superiority and the comparative advantage it has.
- The involvement of farmers and offtakers in variety development and release process would add value to variety uptake. Widening the array of stakeholders involved in variety development and release process will generate a more diverse and complete picture of consumer needs in the market.
- Closer business collaboration between grain offtakers, seed producers and farmers:

Such business collaboration would allow grain offtakers to facilitate quality seed access to farmers who can therefore produce the specified variety type and quality that meet the consumer demand. This could take the format of contract farming fostering market innovations that benefit all key players.

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