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ARTICLE

Preferences for Seed Quality and Cultivar Characteristics of Peanut (*Arachis hypogaea*) by Farmers in Ghana

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ABSTRACT

Peanut remains a major staple and important cash crop in Ghana. Seed quality is a critical component of successful peanut production in Ghana. A survey of 200 peanut farmers documented perceptions of seed quality attributes in 2019 in the Northern, Upper East, Upper West, Bono East, and Ashanti Regions of Ghana. Farmer-saved seed was the main source of seed for planting. High germination rate was the primary attribute of seed in the selection process. Farmers indicated that a premium would be considered for high quality seed. Farmers also agreed that certified seed and farmer saved seed provided high quality relative to seed found in local markets with respect to cultivar purity, germination, and seedling vigor. Shitaochi was the most popular cultivar. Early maturation was the most desired characteristic listed by farmers. These findings support the need for greater investment in seed quality for certified seed production and the need for improved regulation of seed sold in open markets.

INTRODUCTION

Similar to most crops in developing countries, the production, selection, and exchange of peanut (*Arachis hypogaea* L.) seed in Ghana occurs among farmers and traders. In addition to access to improved cultivars, quality of available seed is important in increasing peanut yield (Asante *et al.*, 2017; Fosu-Mensah *et al.*, 2012; Hodgkin *et al.*, 2007; Puozaa *et al.*, 2021; van Etten *et al.*, 2016). Farmers mostly choose the best-looking peanut pods out of their own harvest to serve as seed in the following cropping cycle. The formal peanut seed system composed of governmental and private organizations has minimal participation in supply of peanut seed to smallholder farmers in Ghana (Anonymous, 2016). Peanut seed delivery within the

formal seed system is subject to constraints limiting access by smallholder farmers including high costs of maintaining breeder and foundation seed by research institutions, lack of quality control and assurance, and limited capacity of the private sector to produce certified seeds (Anonymous, 2016). Lack of awareness among farmers about improved seeds, limited market presence, and weak links with output markets also limits effectiveness of the system.

Urrea-Hernandez *et al.* (2016) suggested that inadequate knowledge of characteristics of potato (*Solanum tuberosum* L.) cultivars (e. g., cultivar purity, presence of disease, seed size,

etc.) in the current delivery of seeds limits the effectiveness of the informal seed system. Asiedu-Darko (2014) indicted that farmer knowledge and perception of technology and innovation are key factors influencing the decision to adopt improved practices and inputs and are often limited by cultural and traditional conditions. Bishaw *et al.* (2011) reported that farmer perception of quality and value of certified seed was essential for adoption of improved cultivars distributed through certified seed programs in wheat (*Triticum aestivum* L.). Kuisa *et al.* (2017) assessed the perception of farmers on factors that contribute to chronic aflatoxin (caused by *Aspergillus flavus* and *A. parasiticus*) contamination in corn (*Zea mays* L.) and reported that 95% of the farmers agreed that delayed harvesting and storing of grains at moisture content above 13% encouraged pathogen growth and development.

According to Meijer *et al.* (2015), farmer perception is referred to as their views of a given technology in terms of their perceived needs and prior experiences. Bishaw *et al.* (2011) reported that 57% of farmers cited perception of good seed quality as a reason for acquiring seed from off-farm, local seed sources (e.g., other farmers or local traders) while 61% perceived that saved seed from their production from the previous cropping cycle was more effective in achieving higher quality seed. Consequently, sourcing of seeds by farmers from any source is largely governed by farmer perception of the source and not necessarily through a rigorous review of the sources by a third party.

Increasing understanding of cultivar preferences of farmers and reasons for their decisions are critical defining more effective strategies to increase access to higher quality seed. Farmer preferences have been identified as a major factor that influences farmer seed sources (Bishaw *et al.*, 2011; Mekbib, 2007). One factor that determines farmer choice of seed is the availability of cultivars to meet their needs (Remington *et al.*, 2002).

Konja (2019) reported that smallholder farmers in Northern region of Ghana preferred certified peanut cultivars that were high-yielding, early maturing, germinated quickly and uniformly, had a high percentage of larger kernels, tolerated drought, and expressed resistance to economically important pests. Similarly, Banla *et al.* (2018) indicated that peanut farmers in Togo preferred cultivars with high yield potential, drought tolerance, appropriate kernel and pod size for the market.

Given information in Ghana is limited with respect to farmer perceptions of seed quality and observations of seed sources are limited, a survey was administered in Ghana to document farmer preferences with respect to seed quality.

MATERIALS AND METHODS

Farmers from ten districts in Ghana were selected during 2019 for the survey and included: Kassena-West and Nabdum in the Upper East region; Nadowli-Kaleo and Daffiama-Bussie-Issa in the Upper West region; Savelugu, Tolon, and Kumbungu in the Northern region; Techiman and Techiman North in the Bono East region; and Ejura-Sekyedumase in the Ashanti region. These districts are located in the top five peanut production regions of Ghana and are distributed across the Guinea Savannah and Transitional agro-ecological zones of the country (MOFA, 2016 2017). Combined, these regions

constitute approximately 98% of peanut production in Ghana (MOFA, 2017). The Guinea Savannah zone covers the Northern, Upper West, and a major part of the Upper East regions constituting 63% of the land area in Ghana characterized by unimodal rainfall distribution pattern with a single crop cycle from July - September (MOFA, 2017). Techiman Municipal, Techiman North, and Ejura-Sekyedumase districts are located in the Transitional agro-ecological zone that has a bimodal rainfall distribution with potential for two cropping cycles from March - July and September - October (referred to as major and minor seasons, respectively). The Transitional Zone occupies about 28% of Ghana's land area (MOFA, 2017). These two agro-ecologies differ in temperature, rainfall patterns, and soil characteristics. The Transitional zone experiences a mean rainfall of 1300 mm/year while the Guinea Savannah has a mean rainfall of 1100 mm/year. Two communities within each district were randomly selected from the list of peanut producing communities within the district. Ten farmers were randomly selected from each community for the survey. A total of 200 farmers completed the survey.

Survey data were acquired through a self-designed questionnaire with 32 questions based on the literature to assess farmer perceptions and preferences relative to quality of peanut seeds. The questionnaire was divided into three sections. The first section included information on socio-demographic data of farmers. The second section included questions associated with production practices relative to seed sources and seed quality. The final section was designed to determine the general perceptions of farmers relative to seed quality from various seed sources. Each statement on perception assessment was measured using a five-point Likert scale (Likert, 1932) with 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, and 5 = strongly agree. Each statement for preferences study was measured on a four point ranking scale where 1 = least preferred, 2 = somewhat preferred, 3 = preferred, and 4 = most preferred. Questionnaires were administered to farmers in the form of a structured interview. The questionnaires were originally in English but required translation into the native language of the respondent when necessary.

The Statistical Package for Social Sciences (IBM SPSS Statistics for Windows version 26.0. Armonk, NY) was employed for data analysis. Basic descriptive statistics such as percentages and frequencies were performed in order to describe socio-demographics and production practices of farmers in relation to seed sources and seed quality. Based on the scores of each farmer, a mean perception score was calculated by taking the mean of the overall score that was obtained, by summing up the number of farmers that selected a given level of agreement to the statement by the weight assigned to them (Nguthi, 2007). Frequencies and percentages were computed based on the selected ranks of each farmer on the preferred seed quality attributes.

RESULTS AND DISCUSSION

A higher number of males (67%) than females (33%) planted peanut across all communities (Table 1). Twenty-eight percent of farmers were between 35 and 44 years of age followed by 27% of farmers between 25 and 34 years of age (Table 1). Those who are 24 years old or farmers older than 65 years

comprised 6% and 7% of respondents, respectively (Table 1). Approximately half of farmers did not receive formal education. Eighty-seven percent of respondents indicated that farming was their main occupation while 5% were involved in trading and commerce, 4% were formal salaried workers, and 1% were artisans/vocational workers (Table 1).

Table 1. Demographic and socio-economic information of 200 farmers surveyed in Ghana during 2019.

Variable and category	Frequency	Percent of farmers
Gender		
Male	135	67
Female	65	33
Age in years		
24 and below	11	6
25 to 34	54	27
35 to 44	56	28
45 to 54	39	19
55 to 64	26	13
65 and above	14	7
Education		
No formal education	99	49
Basic/middle	48	24
Secondary/vocational	33	17
Tertiary	20	10
Primary occupation		
Farmer	174	87
Trading and commerce	9	5
Formal salaried work	8	4
Other salaried work	6	3
Artisan and vocational work	2	1
Other	1	1

Peanut in Ghana has been traditionally considered a crop cultivated by female farmers (Kleih *et al.*, 2020; Masters *et al.*, 2013). However, results from this survey suggest a higher level of males involved in peanut production in Ghana. A degree of caution is warranted relative to gender distribution among farmers given the survey was limited to 200 individuals. In a similar study, Konja *et al.* (2019) reported similar distribution in the number of male and female farmers in Ghana. In relation to literacy, 25%, 17%, and 10% of the farmers received basic, secondary, and tertiary levels of education, respectively (Table 1). It is suspected that a low literacy rate of peanut farmers may negatively affect their potential to increase productivity and may restrict farmer understanding and investment in new technologies or adopting improved peanut cultivars and seed for increased productivity. Although not documented here, it is postulated that farmers with greater knowledgeable and information are more likely in a position to understand the benefits of adopting improved interventions and understand interactions among production and pest management practices. Idoko and Sabo (2014) reported that the level of farmer education is positively correlated with adoption of improved technologies. Oyewole and Ojeleye (2015) stated that

education prompts farmers to adopt innovations and technologies that are critical for improving productivity. These results suggest that while educational programs targeted farmers can have value, limitations will likely exist until greater literacy is achieved among peanut farmers.

Equal percentages (37%) of the farmers had 5 to 10 years of experience and more than 10 years of experience cultivating peanut (Table 2). Only 26% of farmers had less than 5 years of experience producing peanut. These results suggest that peanut farmers in Ghana have considerable experience in peanut cultivation and could increase peanut production as new technologies and approaches are proven successful. Verma and Sidhu (2009) indicated that experience of farming is a major determinant of enhancing seed quality.

Fifty-six percent of farmers cultivated peanut on less than 0.8 ha while 39% of farmers cultivated peanut on 0.8 to 2.0 ha (Table 2). Only 3% and 2% of farmers reported to producing peanut on 2.0 to 4.0 ha and greater than 4.0 ha, respectively. Oppong-Sekyere *et al.* (2015) reported that 46% of farmers in Northern Ghana produced peanut on 0.4 to 0.8 ha while only 3% of the farmers cultivated more than 2.7 ha. Owusu-Adjei *et al.* (2017) also reported that land devoted to peanut was often less than 0.8 ha. Land devoted to peanut can impact adoption of new technologies including improved cultivars and seed quality. Relatively small farm size could be an impediment to adoption of improved technology moving forward (Monela 2014; Verma and Sidhu 2009).

Table 2. Farming experience, land size, and primary cultivar for 200 farmers surveyed in Ghana during 2019.

Variable and category	Frequency	Percent of farmers
Years of production		
< 5 years	54	6
5 - 10 years	73	37
> 10 years	73	37
Land size		
< 0.8 ha	112	56
0.8 to 2.0 ha	79	40
2.0 to 4.0 ha	5	3
> 4.0 ha	4	2

Seventy-seven percent of the farmers used saved seed from previous harvest for planting (Table 3). Seventeen percent of the farmers purchased peanut seed from the local markets while 5% exchanged seed with other farmers; received seed as a gift from family members, friends, and neighbors; or as seed provided by non-governmental organizations. Fewer than 2% of farmers obtained peanut seed from the formal sectors including agribusiness dealers and research institutes. Just over 50% of farmers obtained seed for the next season's production immediately after the field is completely harvested and prior to storage. Twenty-three percent of farmers obtained seed as they harvested field while 21% obtained seed at time of sowing.

Table 3. Sources of seed for the next planting cycle for 200 farmers surveyed in Ghana during 2019.

Variable and category	Frequency	Percent of farmers
Main source of seeds		
Own saved seed	155	78
Local open market	33	17
Exchange with farmers	5	2
Gift from family, friends and neighbor	4	2
Certified seed stores	1	1
Research station	1	1
Seed aid from non-government organization	1	1
Alternate source of seed		
Own saved seed	16	8
Local open market	130	65
Exchange with farmers	23	12
Gift from family, friends and neighbor	17	8
Certified seed stores	5	2
Research station	6	3
Seed aid from NGO	2	1
Other	1	1
Time for selecting seeds for next planting cycle		
At time of harvest	47	24
After harvest before storage	111	56
At the time of sowing	42	21

Seed quality, availability of seed, and price of seed were the top three factors affecting the source of seed chosen by farmers (Table 4). Fifty-five percent of farmers ranked seed quality as the primary reason for seed source selection, while only 7%

ranked affordability as the primary reason for their choice of seed source. Smallholder farmers without any alternative source of income most likely will not risk purchase of seed that is not their own because of uncertainty (Etwire *et al.*, 2016). Initially, this could pose a limitation to adoption of improved cultivars.

Table 4. Top three reasons for selecting a particular seed source by 200 farmers in Ghana during 2019.

Category	Primary reason	Secondary reason	Third reason
Affordability	7	18	28
Adaptability	16	26	24
Availability	22	33	31
Quality	55	24	17

Farmers strongly agreed that use of high-quality seed contributed to greater yield of peanut (Table 5). Farmers also indicated that knowing the germination percentages of seeds before planting was important, and that seeds of weeds could negatively impact peanut yield. Farmers indicated that they would pay a premium for seed that was of higher quality. Opoku (2017) showed that farmers' willingness to pay a premium for cowpea (*Vigna unguiculata* L.) seed was positively correlated with their perceived quality of the seed such that farmers are willing to pay higher prices for higher perceived seed quality. Farmers also indicated that treating seed with pesticide prior to storage reduced incidence of disease and insects. Farmers indicated that farmer-saved seeds as well as certified seed had a greater germination percentage and that cultivars were purer than seed purchased in local markets. Uniformity in seed color was also ranked as important attributes of seed quality. Farmers preferred early maturing cultivars. Farmers also indicated that cultivars that could maintain quality across long

storage intervals and tolerance to drought and pests were desired.

Farmers strongly agreed that certified seed with high germination and purity were important characteristics for successful peanut production (Table 6). Farmers also indicated that high germination and purity of their own saved seed were important. Additionally, presence of weeds and other pests in seed were considered important when deciding whether or not to select seed.

Results from this survey indicate that the informal seed system is the main supplier of seeds to peanut farmers in Ghana. The majority of the farmers relying on their on-farm produced and saved seed for planting may be attributed to peanut as a self-pollinated crop that is conducive to saving seed. Limited resources can also reduce ability to access seed from other sources including agribusiness and research institutions that are often more expensive or require cash purchase prior to sowing. The unreliable availability and unpredictable characteristics of

Table 5. Perception of statements relative to seed quality by 200 farmers surveyed in Ghana in 2019.

Statement	Frequency					Mean score	Stand deviation
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree		
Use of high-quality seeds will help increase peanut yield	0	1	10	52	137	4.6	0.6
Knowing the germination percentage of seeds before planting is very important	0	4	25	76	95	4.3	0.8
Treating seeds before storage will help reduce diseases and pest infestation	6	9	48	82	55	3.9	1.0
Seeds of weeds can reduce peanut yield through spread of diseases and pests	0	9	14	78	99	4.3	0.8
Materials used for storage can affect seed quality	4	26	36	70	64	3.8	1.1
Use of recycled seeds often result in low yields	9	23	44	77	47	3.7	1.1
Being aware of the quality status of my seeds is important because it gives me an idea of the output of the production	2	2	43	75	78	4.1	0.9
I do not mind paying higher price for peanut seed if the quality is assured	4	5	20	61	110	4.3	0.9
Overall mean score						4.1	

Table 6. Perception of peanut seed quality from various seed sources by 200 farmers in Ghana during 2019.

Statement	Frequency					Mean score	Standard Deviation
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree		
Seeds from certified sources are of high germination	0	1	60	71	68	4.0	0.8
Seed from certified sources are of high varietal purity	0	5	67	74	54	3.9	0.8
Seeds from certified sources do not contain weed and other crop seeds	3	11	71	59	56	3.8	1.0
Seeds from certified sources are free from pests and diseases	13	5	65	64	53	3.7	1.1
Seeds from local markets are of high germination	28	39	54	68	11	3.0	1.2
Seed from local markets are of high varietal purity	28	46	58	54	14	2.9	1.2
Seeds from local markets do not contain weed and other crop seeds	20	69	57	38	16	2.8	1.1
Seeds from local markets are free from pests and diseases	30	66	53	32	19	2.7	1.2
Own saved seeds are of high germination	2	15	7	74	102	4.3	0.9
Own saved seeds are of high varietal purity	1	15	13	96	75	4.1	0.1
Overall mean score						3.5	

seed sourced from local markets also serve as reasons for used farmer-saved seed for planting. Ojiewo *et al.* (2020) reported that quality seed of improved peanut cultivars in many countries is due in part to constraints in the early generation of the seed value chain. Farmers limit exposure to risk associated with access to seed at the time of sowing by having seed in their possession from the prior season (Almekinders, 2000).

The primary cultivar planted by farmers was Shitaochi (71%), also referred to as Chinese, followed by Manipintar (14%) (Table 7). Ibrahim *et al.* (2012) reported that Shitaochi and Manipintar are the most popular and widely adopted peanut cultivars in Northern Ghana. The results of this current study showed that the most preferred cultivar traits of peanut

by farmers in the country are early maturing varieties that are adapted to local environment conditions. This may have contributed to Shitaochi and Manipintar being predominant cultivars in Ghana. Shitaochi is considered an early maturing cultivar reaching harvest in less than 90 days, possess local market appeal, and is adapted to the local environment. Abdul-Rahman *et al.* (2020) reported that the majority of farmers in Northern Ghana preferred early maturing cultivars to late maturing cultivars even though the late maturing peanut cultivars produced higher fodder and grain yields than early maturing cultivars. Fosu-Mensah *et al.* (2012) reported that smallholder farmers in Ejura-Sekyedumase District in Ghana plant short-season cultivars as one of the main adaption strategies to climate change.

Table 7. Primary cultivar for 200 farmers surveyed in Ghana during 2019.

Cultivar	Frequency	Percent of farmers
Shitaochi	142	71
Kpachi Issah	9	5
Manipintar	28	14
Samnut 22	1	1
Yenyawoso	20	10

More recently released cultivars by the Savanna Agricultural Research Institute and Crops Research Institute have limited adoption rates by farmers in Ghana (Asante *et al.*, 2017; Puozaa *et al.*, 2021). This may be in part due to limited integration of farmers in the process of variety development by public institutions and release of cultivars that do not have a complete set of characteristics deemed important by farmers. Cavatassi *et al.* (2005) suggested that farmers select landraces or historical cultivars over improved cultivars for a number of reasons. A primary cause of limited adoption is absence of attributes farmers desire. Derera *et al.* (2006) reported that despite the availability of new and high yielding corn hybrids, farmers in Zimbabwe continually cultivated corn landraces. Many of the improved cultivars, especially for corn, require fertilizer and pesticide inputs.

Farmers in this survey (Table 8) listed early pod maturation as the most preferred characteristic of a cultivar. This characteristic is most likely desired because of the unpredictable nature of when rains will cease at the end of the rainy season. Cultivars requiring a relatively long window to

complete the growth cycle would be susceptible to drought in some years that could limit yield and increase aflatoxin. Cultivars that could maintain quality for a longer period under storage and were able to withstand drought possess traits that increase adaptability were also important characteristics. Pest resistance and larger seeds were desired less frequently by farmers than early maturation, storage, and drought tolerance. Conversely, cultivars with larger pods, higher oil content, and greater haulm production were desired less frequently than either cultivars expressing pest resistance or producing larger seeds.

The results of this study demonstrate that generally, farmers are aware of the benefits of using high-quality seeds in peanut production. This awareness of the importance of using quality seed by these smallholder farmers is encouraging and suggestive of a critical demand for quality seeds of peanut. According to Maredia *et al.* (2019), farmers should be able to perceive “seed” product as a higher quality planting material than grain and are willing to pay a premium for this higher product. Similarly, farmers perceive their own saved seeds to be either superior or same in quality with seeds from certified seed sources. This may have contributed to farmers using their own saved seed for production. This perception by the farmers will likely increase their reluctance of using improved seeds. This is because in order for farmers to be persuaded to purchase seed from the formal sector, it is imperative that these farmers perceive seed produced by the formal sector to be of improved quality than seed produced by the informal sector.

Table 8. Preference for cultivar characteristics by 200 farmers in Ghana during 2019.

Category	Least preferred	Somewhat preferred	Preferred	Most preferred
Early pod maturation	2	3	23	74
Long storage period	3	4	24	69
Drought tolerance	2	4	26	68
Adapted to local environment	1	3	32	65
Pest resistance	1	3	37	60
Large seed	5	9	30	57
Large pods	4	12	44	41
Oil content	9	20	32	40
Haulm yield	8	13	43	37

Results from this survey should be used with a degree of caution given the relatively small number of participants. None-the-less, results from this survey demonstrate that farmers generally prefer cultivars with traits that are able to tackle problems encountered during production cycle and that are resilient relative to climate change that introduces erratic rainfall patterns. Improved cultivars that have been released recently in Ghana (e. g., Yenyawoso, Sarinut 1, Sarinut 2, CRI-Dehye, and CRI-Agbeyeye) provide higher yield potential and pest resistance compared with traditional cultivars (Anonymous *et al.*, 2018–2019; Owusu-Akyaw *et al.*, 2019). Moving forward, release of cultivars that are adaptable to the local environmental conditions including drought tolerance will continue to be important for success of smallholder farmers in Ghana, especially with concerns about inconsistency of rainfall patterns due in part to climate change (Abdul-Rhman *et al.*, 2020; Chemura *et al.*, 2020; Fagariba *et al.*, 2018).

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