



Empirical examination of the constraints and causes of crop seed losses in Ghana

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ABSTRACT

Development interventions have endeavored to improve the availability of improved seeds to enhance agricultural productivity in West African sub-region. The objective of this study, therefore, was to examine the constraints of seed production and the causes of seed losses in Northern Ghana. We used primary data on farm information collected from 62 seed producers in northern Ghana. The data were analyzed descriptively and supported by the Chi-square test. The results indicated that high input costs, undeveloped marketing system and seed distribution channels, erratic rainfall pattern, and inadequate machinery constituted the main challenges for seed producers. Field pests, poor storage structures, poor farm hygiene, and poor bagging process significantly influenced seed losses. We recommend, among other interventions, that agricultural policies of Ghana, such as “the planting for food and jobs” and the agricultural input subsidy program, provide seed producers with technical and financial support to reduce cost of production and seed losses. There is also the need to strengthen seed trade associations to provide technical backstopping and the needed services to actors in the seed value chain of Ghana.

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Introduction

Seed is the fundamental life-blood of agriculture and the foundation of successful farming for smallholder crop farmers in the dry-land tropics (Mula et al. 2013). Seed is one of the most crucial elements in the livelihoods of agricultural communities and has been identified as being very important for any crop-based production system (Etwire et al. 2013). In fact, the American Seed Trade Association’s motto is “First-the seed” (<https://www.betterseed.org/>).

Food security is heavily dependent on the seed security of farming communities. The use of quality seed can contribute significantly toward increasing grain yield and daily food intake (FAO 2017). The Ghana National Seed Plan (2015) also affirms that quality seeds are a prerequisite to successful

agriculture and constitute a major pathway for achieving the national food security goal of Ghana. The plan further asserts the need for the availability and intense utilization of quality seeds that are adapted to the target production environments. However, inadequate availability or non-availability of quality seeds and certified seeds for crop production seems to be the main production constraint in northern Ghana. Consistent with the theory of Louwaars and De Boef (2012), many projects, such as “Feed the Future USAID-Ghana Agricultural Technology Transfer (ATT)” project and the Agricultural Value Chain Enhancement (ADVANCE) II project, have endeavored to improve the quality and availability of seeds to enhance agricultural productivity.

According to Etwire et al. (2013), the formal, informal, and intermediary (a fusion of the first two) seed systems are the dominant seed systems in Ghana. The informal seed system serves about 80% of farmers across all major food crops in Ghana.

Etwire et al. (2013) categorized the production constraints into challenges of the informal and formal systems. They noted the main constraint of the informal system to be the reliance on nature for production, which could cause some seed shortage in the event of extreme weather conditions, such as drought or flooding. Etwire et al. (2013) and Louwaars and De Boef (2012) also found the informal seed system to be mostly inadequately prepared for pests and diseases, leading to production losses. As Etwire et al. (2013) noted, the formal seed system has been receiving support from different stakeholders, such as Feed the Future USAID Ghana Agriculture Technology Transfer project. This support has come in the form of direct technical support in the field, as well as in the form of breeder seed, foundation seed, and credit support to growers to enhance community-level seed production. For the formal seed system, where the Ministry of Food and Agriculture (MoFA) controls more than 80% of the activities in the sector, Etwire et al. (2013) noted the delay in the provision of services to the seed producers resulted in serious post-harvest losses. These services include registration of seed growers, cleaning and grading of seeds, seed inspection and certification, and packaging for sales. The distribution system, from certified seed production stage to the farmers, is normally inadequate. The sector also suffers from inadequate storage structures (cold rooms) and competition from the influx of imported and spurious seeds.

Seed loss refers to decreased seed mass throughout the different segments of the seed supply chain – production, postharvest handling, processing, storage and distribution (wholesale and retail) (FAO 2014). This study defines postharvest loss as a decline in the quantity or quality of seed, which can occur in any of the various postharvest phases.

In Ghana, as already mentioned, the formal seed sector provides far less quantities of seed than desired. The informal seed sector supplies the bulk of the seed needed by the farmers (Ministry of Food and Agriculture [MoFA] 2015; FAO 2013); the quality of seed from this sector is questionable, however. This study, therefore, sought to investigate the constraints related to the availability of quality seeds of rice (*Oryza sativa* L.), maize (*Zea mays* L.), and soybean (*Glycine max* (L.) Merr.) to farmers; determine the losses occurring at the various stages from seed production to storage; and examine the causative factors of these losses. We also assessed farmers' knowledge about preventive measures needed to avert seed losses.

Materials and methods

The study employed a multi-stage sampling technique to select 62 respondents from a list of seed producers in the three northern regions of Ghana (i.e. Upper East, Upper West, and Northern region). In the first stage, cluster sampling was used to select seed producers from these three regions. Simple random sampling techniques (lottery method) was then used to select 62 respondents from a list of about 90 seed producers, who received support from Feed the Future USAID-Ghana Agriculture Technology Transfer (ATT) project. Primary data were then collected on constraints to seed production, causes of crop seed losses and farmers' knowledge of measures for preventing crop seed losses. The primary data were collected using a questionnaire via face-to-face interviews with the seed producers. In addition, key personnel at the Ghana Seed Inspection Units (GSIU) of the respective regions and the ATT project's seed specialists were interviewed to obtain their perspectives.

Analytical framework

Following Azumah, Donkoh, and Awuni (2018), we employed central tendency (mean) supported by Chi-square test to measure the goodness of fit as well as weight of the responses of seed producers on a Likert scale of 1–5; 5 being the strongest response and one being the weakest response. This was done by using Stata 14 (StataCorp 1985) and Statistical Package for Social Science (SPSS) version 20 software. Chi-square distribution assumes the following:

Given that X_1, \dots, X_n are i.i.d. $N(\mu, \sigma^2)$ random variables, then:

$$\sum_{i=1}^n (X_i - X^*)^2 \sim \sigma^2 X_{n-1}^2 \quad (1)$$

where

$$X^* = \frac{1}{n} \sum_{i=1}^n X_i \quad (2)$$

X_i is observed response of the i^{th} farmer, X^* is the expected response, and n is the sample size.

To ascertain the course of seed losses, a five-point Likert scale (1 = weakest response; 5 = strongest response) was used to solicit information from the respondents (seed producers under the ATT project). Mean values were then computed for ease of analysis. The five-point Likert scale was also used to ascertain the level of farmers' knowledge of methods of preventing seed losses, with 5 = farmer having strong knowledge about the preventive method and 1 = farmer having least knowledge about the use of a particular preventive method.

Results and discussion

Constraints to seed production in Northern Ghana

In this section, we discuss the results relative to the major challenges facing the seed production system in the three northern regions of Ghana. Eleven (11) out of the 12 identified constraints were found to be statistically significant, implying a general agreement among the respondents about the existence of these constraints to crop production. Only "availability of good land for seed production" was statistically nonsignificant (Table 1).

The results (Table 1) indicated that high input costs for seed production, undeveloped marketing system and seed distribution channels, erratic rainfall pattern, and equipment (machinery) cost constituted the main challenges to seed production in northern Ghana. In addition, low demand for certified seed and the lack of good government policy direction relative to pricing and subsidy for the seed production sector were identified as major challenges to seed production in northern Ghana. The respondents ascribed some of the challenges of the seed sector to crop losses caused by rodents, birds, insects, and diseases, inadequate processing, and seed storage

Table 1. Constraints to seed production in northern Ghana.

Constraint	Mean	Std. Dev.	χ^2
High cost of inputs	4.39***	0.95	75.742
Undeveloped marketing and distribution channels	4.24***	0.9	52.839
Erratic rainfall pattern	4.19***	1.14	57.032
Equipment	4.16***	1.06	47.355
Low demand for certified seeds	3.98***	1.25	40.581
Government Policy	3.86***	1.08	25.903
Crop losses caused by rodents, birds, insects and diseases	3.85***	1.23	27.839
Poor or lack of drying and storage facilities	3.74***	1.38	23.161
Timely harvesting	3.52***	1.1	23.968
Technical knowledge of seed producer	3.16*	1.37	9.452
Improper production planning	3.15***	1.27	14.29
Availability of good lands	3.21	1.38	4.452

*, and *** Significant at 5% and 0.1% probability level, respectively.

Source: field data, 2017

infrastructure, and lack of expertise of most seed producers in planning production activities. Despite heavy investments by the ATT project in infrastructure and technical training of seed producers in the study area, we found some challenges that resulted in seed losses. It, therefore, suffices to say that infrastructure and training of farmers were not enough to prevent seed losses. Farmers need sufficient funds to invest, for instance, in the management of rodents and insects and in acquiring further technical knowledge in production planning.

According to the Ghana National Seed Plan (2015), one of the major problems of the sector was a low investment in the sector by the government. The overwhelming poor access of farmers to production credit from formal banking institutions further constrained seed production investments to tackle the losses at various stages. The results (Table 1) also revealed inadequacy of storage and drying facilities, raising serious quality assurance issues and resulting in postharvest aflatoxin contamination of seed.

Causes of seed losses in Northern Ghana

The study revealed that field pests and poor storage structures were the main causes of seed loss among farmers in northern Ghana (Table 2). In their study on the integrated seed sector development in Africa, Louwaars and De Boef (2012) also found pests and diseases as a main challenge, leading to seed losses in the informal seed system. However, the issue of storage infrastructure has not been adequately tackled to reduce losses. Projects such as Feed the Future USAID-Ghana Agriculture Technology Transfer (ATT) had only intervened to improve infrastructure of the Ghana Seed Inspection Unit at regional MoFA offices to improve research and seed testing. Past and present government policies on warehousing have concentrated on storage structures for grains, with minimal or no attention

Table 2. Causes of seed production losses.

Causes of seed loss	Mean	Std. Dev.	χ^2
Field pests	3.65***	1.282	13.323
Poor storage structures	3.40***	1.4195	15.419
Poor harvesting methods	3.24	1.3989	5.258
Mould and fungi during wet seasons	3.13	1.4082	0.742
Poor threshing methods	3.08	1.371	3.968
During transportation	3.06	1.413	0.258
Low planting density	3.05	1.348	4.29
Improper cleaning and drying	2.92	1.2584	6.226
Bagging process	2.89**	1.161	11.871
Poor land preparation	2.81	1.3286	3.323
Improper fertilization	2.74*	1.267	8.161
Seed impurities	2.68**	1.212	9.774
Poor farm hygiene	2.57***	1.1253	18.484

*, **, *** Significant at 5%, 1% and 0.1% probability level, respectively. (N = 62).

Source: field data, 2017

toward seed storage. Storage structures at the seed units of regional MoFA (for the formal seed sector) are limited, and can only cater for seed that meets just 20% of the total seed demand. Poor farm hygiene, inappropriate bagging process, and seed impurities were also found to cause significant seed losses. This might be attributable to farmers' lack of knowledge on proper farm maintenance and seed handling.

Farmers' knowledge on prevention of seed losses in Northern Ghana

The results revealed a generally low level of understanding of seed producers regarding the application of preventive measures to avert seed loss (Table 3). Among all the factors, the seed producers had the least knowledge about the proper use of chemical pesticides to prevent seed losses (i.e. mean = 1.36), both at the field and at post-harvest levels. Such a low level of knowledge has been shown to lead to loss of flavor, color, texture, and nutritional value attributable to pesticides and chemical reactions in the seeds (Atanda et al. 2011).

The farmers indicated the low levels of input from extension agents as the dominant factor that accounted for their inability to understand the chemical composition and spraying regimes of most of the chemicals. The low levels of formal education among farmers of the three northern regions of Ghana (Ghana Living Standard Survey [Round GLSS 6] 2014), coupled with the low Extension Agent – Farmer ratio in Ghana (1:1500) (MoFA website 2018), were responsible for the availability of reduced amount of information to the seed producers, especially on use of chemical seed treatment. The Ghana Seed Inspection Unit (GSIU) of MoFA (which has oversight responsibility over the seed sector in northern Ghana) also faces challenges relative to resources and has just recently been assisted by the Feed the Future USAID Ghana Agriculture Technology Transfer project to construct new and modern seed testing laboratories in the three northern regions of Ghana. An interview with personnel of Ghana Seed Inspection Unit (GSIU) of Ministry of Food and Agriculture (MoFA), revealed a low level of motivation among

Table 3. Farmers' knowledge on measures to prevent seed losses.

Knowledge area	Mean	Std. Dev	χ^2
Proper sorting and packaging	1.69**	0.74	9.129
Management of pest and diseases	1.60***	0.56	26.161
Proper use of storage facilities	1.42***	0.62	31.871
Proper drying, maintaining good hygienic conditions	1.37***	0.58	37.774
Use of chemicals, pesticides to prevent losses	1.36***	0.66	43.194
Laying traps for rodents, other animals	2.06	0.74	4.29
Using hermetic bags for storage	1.84***	0.68	11.742

** , *** Significant at 1% and 0.1% probability level, respectively. (N = 62).

Source: field data, 2017.

staff and a heavy burden of inadequate staff to manage the on-farm and off-farm supervision of the activities of the seed producers.

The farmers had low level of knowledge of proper seed drying processes and general maintenance of seed hygiene (Table 3). Seed drying is important because it reduces respiration in seeds. Seed drying also impedes qualitative damage attributable to fungi and insect pests. The results (Table 3) also indicated that the seed producers were poorly educated on seed storage processes and systems (1.42) and on the use of hermetic bags for storage.

Conclusions and policy implications

We concluded that high input costs, undeveloped marketing system and seed distribution channels, erratic rainfall pattern, and inadequate equipment (machinery) constituted the main challenges for seed production in Northern Ghana. Field pests, poor and inadequate storage structures significantly influenced seed losses among seed producers. Generally, there was a low level of understanding among seed producers regarding the application of preventive measures to avert seed losses. It is important that national agricultural policies of Ghana, such as “the planting for food and jobs” and the agricultural input subsidy program, support seed producers in Northern Ghana to reduce costs and to adopt best practices for seed production. The government should consider including machinery, such as harvesters, to the package given to farmers under the support programs. The Agriculture extension unit of MoFA should also intensify education on seed loss preventive measures. To increase the resilience of the seed system and to enhance food security in Ghana, strong private sector leadership in the form of a vibrant seed sector association is required. There is also the need for collaboration among the government of Ghana and organizations, such as the International Fertilizer Development Centre (IFDC), and the Savannah Agricultural Research Institute (SARI), to identify, multiply and supply seed of improved and drought-tolerant varieties to producers. A mechanism for seed distribution should be established and managed by the National Seed Trade Association of Ghana (NASTAG) with support from the Ministry of Food and Agriculture (MoFA) and all other stakeholders within the seed sector of Ghana.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Data availability

The data for this study will be provided upon request.

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