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Effect of Traditional Farming Practices on the Yield of Indigenous Kersting's Groundnut (*Macrotyloma geocarpum* Harms) Crop in the Upper West Region of Ghana

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Kersting's groundnut (*Macrotyloma geocarpum* Harms) is an indigenous subterranean legume crop grown by small-scale farmers in the Upper West Region of Ghana. This legume has a high protein content and is also of socio-cultural importance. It has been neglected by researchers despite the important role it plays, such as traditional funeral rituals for orphans of the deceased, in the rural farming communities where it is grown. A survey conducted on the status of indigenous crops in the Upper West Region resulted in the collection of 138 crop samples and revealed that only a few, older, small-scale farmers still cultivate Kersting's groundnut. To examine the reasons why this legume gives lower yield when cultivated by small-scale farmers in the rural communities three Kersting's groundnut farmers, from the Boli community in the Wa district and Lilixsie and Nimoro communities in the Sissala district, were selected and financially supported by the Northern Savanna Biodiversity Conservation Project to promote, reproduce, and conserve the seed of the Kersting's groundnut through the establishment of *in situ* conservation fields under natural rainfall conditions. Traditional farming practices used by the selected farmers were found to have an influence on the low yields that were obtained. Traditional random planting (not planted in rows) and the practice of weeding only once may have greatly contributed to the lower mean yields of 178 kg/ha, 250 kg/ha, and 124 kg/ha for the white, black, and mottled cultivars, respectively. In order to improve yields, it was recommend by Buah *et al.* (2007) that Kersting's groundnut fields that are sown in June be weeded a minimum of two times (third week after planting and sixth week after planting) and have an inter-row spacing of 0.30 m and intra-row spacing of 0.20 m. Applying these recommendations to fields planted on tropical Savanna soil and using natural rainfall as the water source will help to ensure that small-scale farmers in the Upper West Region maintain adequate control of weeds for maximum yields.

Key words: indigenous legume crops, *in situ* conservation, inventory, Kersting's groundnut, small-scale farmer, traditional farming practices

1. Introduction

1.1 Origin and background

Kersting's groundnut (*Macrotyloma geocarpum* Harms) is an indigenous, high protein, subterranean, herbaceous legume that is grown in the semi-arid and arid areas of West Africa by older farmers (Messiaen, 1994; Aremu *et al.,* 2006). It is mainly grown for its edible seeds by farmers on a smaller scale, giving lower yields (Schmidt, 1943; Baudoin and Mergeai, 2001; Buah *et al.,* 2006). The rooting system is superficial, producing subterraneous nuts. Baudoin and Mergeai (2001) reported that the Kersting's groundnut is a typical West African plant whose wild ancestral forms were discovered in Cameroon and the Central African Republic on the banks of the Ubangi River. It is predominantly cultivated in the semi-arid to arid areas of all the

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coastal countries along the Gulf of Guinea from Senegal south to Guinea Bissau, northern Ghana, Togo, Benin, northern Nigeria, and Cameroon (Baudoin and Mergeai, 2001). It is also cultivated in Burkina Faso, Niger, and Mali. Schmidt and Marcus (1943) reported the cultivation of this crop in Madagascar and some parts of the Asian continent as well.

Legume crops are the most commonly found cheap source of protein for farm family households in the Upper West Region of Ghana. Cowpea (*Vigna unguiculata* L. Walp.), bambara groundnut (*Vigna subterranean* L. Verdc.), and groundnut (*Arachis hypogaea* L.) are the legume crops that are cultivated in the four districts (Lawra, Jirapa/Lambussie, Sissala, and Wa) of this region. Cowpea is widely cultivated as an early crop and consumed by farm families as a substitute for animal protein. It also serves as a "hunger" relief crop for farmers between May and July annually. This period is usually the beginning of the farming season in the Upper West Region, and it is termed the *hunger gap* period. This is because many farmers have usually exhausted all the produce of the previous harvest as household food so they rely entirely on the production of early maturing legume crops such as cowpea. However, the production of cowpea requires a certain amount of money to acquire improved certified seed and to control pests and diseases in order to improve yields. James *et al.* (2002) reported that grain losses of cowpea due to insect pests are a constraint to cowpea production. Jackai and Daoust (1986) stated, "The pest spectrum is wide and practically every part of the cowpea plant has an adopted pest species". Similarly, Onwueme and Sinha (1991) reported thrips, flower beetles, pod-sucking bugs, and *Maruca testulalis* as the major insect pests of cowpea. Oparaeke *et al.* (2006) noted that some of the disadvantages of the use of insecticides by rural farmers to control the cowpea flower bud thrips (*Megalurothrips sjostedti* Trybom) were the high cost of the chemicals and the high level of technological requirement. Unfortunately, financial limitations result in many small-scale farmers cultivating this crop without controlling for aphids, thrips, and pod borers, virtually ensuring poor harvests and limiting an available protein source for small-scale community farmers. There is a need to identify a suitable substitute crop that is tolerant of these numerous pest species, that can be locally grown, that is affordable and sustainable, and that can supplement the nutritional needs of the rural farm household.

Groundnut and bambara groundnuts are more widely cultivated legumes by farmers in the Upper West Region than is Kersting's groundnut. However, groundnut is mainly cultivated for its edible oil and paste, which is usually extracted by local industry, and is regarded as a food cash crop by farmers in the region; it is consumed less than cowpea and bambara groundnut in most households. The bambara groundnut crop serves as a supplementary food crop to many farm households in the region. It is the third most important legume crop grown by farmers after groundnut and cowpea crops.

Baudoin and Mergeai (2001) described Kersting's groundnut as an indigenous West African legume crop that is drought-resistant, well adapted to the Sudano-Guinean Savanna agroecological zone, and less susceptible to pests and diseases than most other crops. These unique characteristics of Kersting's groundnut seem to make it a suitable productively sustainable crop of choice to mitigate the prevailing low-protein situation in the rural farm communities where it is cultivated compared to the cowpea crop, which is susceptible to pests and diseases in the Upper West Region. Kersting's groundnut as a landrace is more endangered compared to groundnut and bambara groundnut among the small-scale farmers in the Upper West Region (Ministry of Food and Agriculture, 2004).

1.2 Importance of Kersting's groundnut in rural communities

Many Africans and Europeans prefer Kersting's groundnut seeds to cowpea and bambara groundnut due to its palatable taste and high-protein content (Baudoin and Mergeai, 2001). The seeds and leaves are used for food in the rural farming communities. The Kersting's groundnut has been reported as having a high quality nutritional level, with 12.9% protein compared to 12.1% and 7.1% for bambara groundnut and cowpea, respectively (Aremu *et al.,* 2006). Its high protein content has been valued for many years by rural communities in the Sissala area of the Upper West Region, where orphan children are fed the boiled seed of this leg-

ume in the mornings (Schmidt, 1943).

In the Upper West Region of Ghana, the cooking water from Kersting's groundnut seed is used for the treatment of stomach pains and intestinal cramps and as an antidote to food poisoning, inducing vomiting when ingested. Concoctions prepared from the leaves act as a febrifuge. The seed is also used in the preparation of special foods for funeral rites in the rural communities. Pastries, such as bean-cakes ("Koose") and steamed pastes ("Tubani"), are made from the flour of its seed (Buah *et al.,* 2006; Stanley, 2006).

1. 3 Current situation in the Upper West Region

Traditionally, the farming season in the Upper West Region begins between late April and May. Inland valley land is prepared for late maturing rice and early maize cultivation by using a tractor disc plough, a bullock/donkey-drawn plough, or a manual hand hoe. Cowpea, groundnut, and maize are usually planted by farmers as early crops in the upland fields between May and June for harvest between July and August. These crops are used as an early source of food for the farm households. The cowpea crop is mainly used as a source of food for people who work in the fields during the early farming season. Sorghum, millet, bambara groundnut, and Kersting's groundnut are planted between July and August and are usually harvested around October to January. These crops are generally the last cereal and legume crops to be harvested from the fields. However, some bambara groundnut cultivars mature early and are harvested for food between August and September to complement the household food reserves from the previous harvest until new crops are harvested.

Sorghum and millet are usually intercropped with cowpea, bambara groundnut, and groundnut. The legumes are first harvested between July and September, depending on the maturity of the legume intercrop, while the cereals are harvested between October and January. The long maturing crops of sorghum, millet, groundnut, and bambara groundnuts are planted as mono crops by some farmers. Planting of sorghum and millet is done on mounds or flat ground in a random formation (not in rows). The legume intercrops are then planted along the sides of the hoe-constructed mounds or in-between the flat random spaces. The sorghum or millet crop is planted on top of the mound as the main crop. Weeding is carried out in the fields by using a hand hoe. The weeding frequency of each field depends on the ability of the farmer to provide labor to cover all the other crops, such as yam, maize, and rice. The major food crops, such as sorghum and millet, are weeded frequently compared to the minor crops when the farmer has many fields to attend to and a limited labor force.

Kersting's groundnut is planted without other crops either on flat land or mounds in small areas usually not exceeding 0.25 ha. Some farmers infrequently intercrop it with late-maturing maize, millet, or sorghum and harvest it in October or November, which is slightly earlier than the cereals.

1. 4 A focus on Kersting's groundnut in the Upper West Region

Only a few elderly farmers cultivate the Kersting's groundnut on a small scale for home consumption in the Upper West Region despite its importance role as a source of protein, better adaptation to the local climatic conditions, and lower production costs compared to cowpea. In an attempt to understand the status of some neglected indigenous legumes crops, a survey of indigenous crop varieties was conducted in the region in 2003; this survey was supported by the Northern Savannah Biodiversity Conservation Project (NSBCP) in collaboration with the Ministry of Food and Agriculture (MOFA) and the Savanna Agricultural Research Institute (SARI) in the Upper West Region of Ghana. Four districts (Wa, Jirapa/Lambussie, Lawra, and Sissala) out of the then five districts in the region were selected for the survey based on major differences in farming practices, major crops grown, and agroecological locations.

The survey revealed that most farmers abandoned the cultivation of Kersting's groundnut due to the laborious nature of harvesting it and the low yields of the crop compared to other similar crops, such as improved cowpea varieties. Kersting's groundnut is considered a "neglected and poor man's" crop because it has been ignored by researchers in spite of its potential contribution to the nutritional and health status of people in rural communities where it is mainly cultivated. Little is known about the improved agronomic management practices carried out by farmers who still cultivate

it. The present farming practices are based on traditional knowledge inherited from generation to generation, and these practices along with the seed as a rich genetic resource are gradually disappearing compared to other indigenous crops, such as bambara groundnut, cowpea, and groundnut in communities that use modern agricultural techniques. As a result, Kersting's groundnut is a landrace threatened by extinction in the near future if measures are not taken to forestall this anomaly in the agricultural sector.

Indigenous crop varieties provide the main source of planting material to most farmers in rural communities of developing nations because of the rapidly increasing cost of improved crops seeds (Ghana Plants Genetic Resource Centre, 1996), which few rural farmers have access to. In the case of the Kersting's groundnut, farmers only have access to a few existing seeds within specific communities where it is cultivated. The seed of Kersting's groundnut has been in the possession of a few farmers despite its low-yielding capacity probably because of the socio-cultural and nutritional roles it plays in the communities where it is still cultivated (Ministry of Food and Agriculture, 2004).

In the present study, I focus on how traditional farming practices affect the yield of Kersting's groundnut under natural rainfall conditions and on a small-scale level of production compared to yields obtained from improved management practices using recommended row spacing. I have also designed this study to promote the cultivation, use, and conservation of the Kersting's groundnut seed as a landrace in communities where it is cultivated through *in situ* conservation, seed multiplication and promoting public awareness.

2. Materials and Methods

An inventory of traditional indigenous crop varieties was conducted in Wa, Jirapa/Lambussie, Lawra, and Sissala districts of the Upper West Region of Ghana in April 2003 (Fig. 1). Information was collected using simple questionnaires during interviews with farmers and during focused discussion groups (Fig. 2). One hundred and thirty-eight of the farmers interviewed were cultivating indigenous cereal and legume crops alongside similar, introduced, improved crop varieties. One hundred

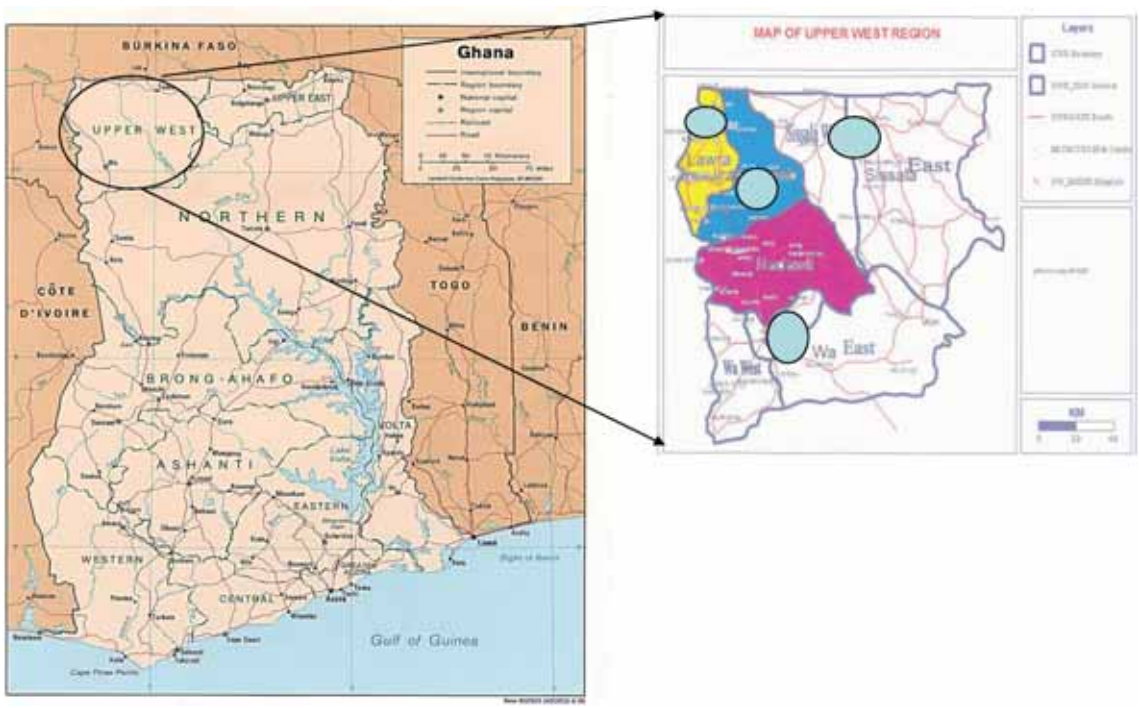

Fig. 1. Map of Ghana and the Upper West Region showing the districts where the inventory of indigenous crops was conducted in April 2003.
Source: http://www.lib.utexas.edu/maps/africa/ghana_pol96.jpg

Fig. 2. Focused group discussions with farmers of the Wa district, Ghana, during the indigenous crops inventory.

Fig. 3. Locations of the three fields in the Wa and Sissala districts, Ghana, that were used for growing Kersting's groundnut by the grant-supported farmers.
Source: http://www.lib.utexas.edu/maps/africa/ghana_pol96.jpg

and thirty-eight crop samples of indigenous cereals and legumes were presented as the major cultivated crops by these farmers during the survey.

Twenty of these farmers were randomly selected from the 138 farmers who provided crop samples during the survey and were provided with financial support by the NSBCP. These farmers provided legume samples of Kersting's groundnut, cowpea, groundnut, and bambara groundnut, which had

Fig. 4. Randomly sown field of Kersting's groundnut by a grant-supported farmer in the Sissala district.

been cultivated as a major crop during the previous farming season (in 2002). Three of these farmers, from Boli, Lilixsie, and Nimoro communities in the Wa and Sissala districts, cultivated Kersting's groundnut (Fig. 3). These three farmers were selected to establish *in situ* conservation fields of white, black, and mottled seed colors of Kersting's groundnuts during the 2005 and 2006 farming seasons and were financially supported by the NSBCP.

The three fields were prepared using a tractor-drawn disc plough and were sown on different dates between the third and fourth weeks of July 2005 and 2006. The traditional method of sowing (random, not in rows; Fig. 4), by dibbling seeds into holes with sticks, on tropical savanna soils was used under natural rainfall conditions in the three different farming communities. The white-seeded Kersting's groundnut was cultivated across a 4,000-m^2 field at Boli in the Wa district, whereas the black-seeded and mottled seeded Kersting's groundnuts were cultivated across a 2,000-m^2 field at Lilixsie and Nimoro, respectively, in the Sissala district. Weeding by hand hoe was carried out once between the third and fourth weeks of August after sowing all fields. No fertilizers or pesticides were used.

The fields were harvested during the last week of November, and the grain yields of the entire harvest of the three different locations were obtained. These yields were compared to Kersting's groundnut yields obtained by using improved row-spacing management practices at an indigenous crop

Fig. 5. Kersting's groundnut field sown using improved row-spacing management practices.

Fig. 6. Kersting's groundnut crop under cultivation with improved row spacing at the Poyentanga demonstration and multiplication garden, near Wa, Ghana.

demonstration and seed multiplication garden in Poyentanga in the Wa district (Figs. 5 and 6). The Kersting's groundnut seeds used in the row-spacing experiments were collected from farmers during the inventory survey of indigenous crops in 2003.

3. Results and Discussion

Table 1 presents a summary of indigenous cereal and legume crop samples provided by farmers during the 2003 inventory exercise. Sorghum and cowpea had the largest crop samples of 48 and 21 collections, respectively, out of the 138 samples provided by farmers. The higher number of samples for these crops may indicate that the main staple food of rural farming families in the Upper West Region is derived from sorghum, millet, and cowpea. These crops are cultivated in larger areas compared to the other crops (Table 2), which is in agreement with information provided by Onwueme and Sinha (1991) that cowpea is the second most important food grain legume crop for rural farmers in tropical Africa. The mean age of the farmers who provided the indigenous crop samples and who were still cultivating them was 52 years (Table 1). This is interesting, considering that the national average life span is 59 years (CIA World Factbook, 2007). Kersting's groundnut was provided the least number of times by farmers and only in a few specific communities. This finding is in agreement with that of Schmidt and Marcus (1943) who reported that the infrequent use of Kersting's groundnut in cultivation could be attributed to subsistence cultivation mainly by elderly farmers. Groundnut crop samples were provided most frequently after cowpea by farmers having the youngest mean age (35 years). This is possibly because it is the immediate, common cash crop cultivated by farmers in the Upper West Region. Many young farmers seem to have developed an interest in its cultivation solely as a means to generate income to meet their expenses. Table 1 also shows the number of accessions per each indigenous crop sample collected from the farmers during the inventory. Sorghum had the highest number of different accessions (29), and Kersting's groundnut had the least (3). Sorghum is the most widely planted and important staple food crop cultivated by farmers in the Upper West Region as it is the major staple food and provides raw material for the local brewery industry. However, the genetic variability of the collected indigenous crops is still unknown. Further studies screening varietals of these accessions are required in order to develop and use these indigenous crops in many more farming communities in the region.

Farmers who provided the Kersting's groundnut, cowpea, and bambara groundnut crop samples had a mean age of 53, 55 and 60 years, respectively (Table 1). These legumes are the major source of protein for the small-scale farmers in rural communities and are cultivated annually by almost every household. Aremu *et al.* (2006) claimed that legumes are the major source of plant protein and

Table 1. Summary of indigenous crop samples provided by farmers in 2003

	Number of samples	Number of Accessions	Mean Age of farmers
Sorghum	48 (34.7)[1]	29	57
Pearl millet	15 (11.0)	6	51
Rice	13 (9.7)	9	48
Cowpea	21 (15.2)	11	55
Groundnut	18 (13.0)	17	35
Bambara groundnut	14 (10.1)	14	60
Kersting's groundnut	9 (6.5)	3	53
Total	138 (100)	89	52

[1] Figures in parentheses represent the percentage of farmers

Table 2. Regional cropped area (in hectares) of major crops in the Upper West Region, Ghana (2003–2006)

Year	Sorghum	Pearl Millet	Rice	Cowpea	Groundnut
2003	251,555	125,414	5,477	107,424	224,748
2004	184,795	97,609	8,549	99,355	202,986
2005	89,441	55,064	3,459	33,111	75,185
2006	109,619	51,697	9,166	46,435	80,979

Source: Statistics, Research and Information Division, Ministry of Food and Agriculture, Ghana

fats in tropical countries. Stanley (2006) also reported that, in rural community households in northern Ghana, food legumes, such as cowpea, groundnut, and soybean, were predominantly being grown because of the high cost of animal protein to the average rural farm family.

The area of cultivation for groundnut ranked second after sorghum in the region (Table 2). This suggests that a sizable number of farmers are involved in its cultivation mainly as a cash crop. The groundnut also serves as a hedge crop against inflation when main food crops, such as sorghum and millet, fail. Based on discussions with farmers, cowpea was found to be the second most important and widely cultivated legume crop after groundnuts (Fig. 2).

Table 3 presents the age of farmers who provided indigenous sorghum, millet, rice, groundnut, cowpea, bambara groundnut, and Kersting's groundnut crop samples during the 2003 inventory; local names of crops and locations where the samples were obtained are also shown. The naming of indigenous crops varied from community to community. The naming of the collected crop samples in the local languages was mainly based on the maturity period, the color of the seed, and in some cases the seed form. It was evident that similar crop cultivars had different names due to the difference in ethnicity and locality. The names of these sorghum crops also indicated that most of the collected indigenous crop samples are long-maturing cultivars in all four surveyed districts. Communities in the Sissala and Wa districts predominated in the provision of sorghum and Kersting's groundnut samples while communities in the Lawra district mainly provided groundnut, cowpea, bambara groundnut, and rice samples. Millet was the main sample from the Sissala district. Communities in the Jirapa/Lambussie district ranked third in the provision of cowpea samples after Lawra and Sissala districts, respectively. The predominant crop samples provided by the districts are an indication of the main cultivated crops within the district.

As an initiative to conserve, promote, and multi-

Table 3. Indigenous crop samples provided during the survey, including local names and locations

Table 3–1. Sorghum (*Sorghum bicolor* [L.] Moench)

Farmer's Age (Years)	Community	District	Variety Name (Local Name)	Days to Maturity
55	Yagha	Jirapa/Lambussie	Gyibaraa	180
65	Sawale	Jirapa/Lambussie	Gyibaara	180
59	Gyenvvuur	Jirapa/Lambussie	Tatuor	120
70	Tampala	Jirapa/Lambussie	Pokuori Latuor	150
64	Nyago	Jirapa/Lambussie	Dawelle	180
58	Kuncheni	Jirapa/Lambussie	Kukyebile	180
62	Zambo-Hayieu	Lawra	Dawele	180
68	Zambo-Hayieu	Lawra	Dawelle	180
50	Bikyiinteng	Lawra	Dawel-kale	150
70	Tampalle	Lawra	Beluru	150
60	Bekyiinteng	Lawra	Zikedire	90
68	Kokoligu	Lawra	Zele	120
42	Brifoh-Cha	Lawra	Nyinguo	120
62	Biakanayiri	Wa	Murapai	180
50	Jambusi	Wa	Donboro	150
64	Charia	Wa	Donboro/Oluu	180
60	Charia	Wa	Donboro/Oluu	180
72	Jingo	Wa	Donboro/Oluu	180
80	Sagu	Wa	Ollu-bile	120
33	Sagu	Wa	Pokuori-Latuori	150
75	Chaggu	Wa	Dafaalo	195
40	Jambusi	Wa	Kapiela	120
65	Jambusi	Wa	Cheri	90
36	Paase	Wa	Kabile	90
59	Jambusi	Wa	Chekpuri	120

ply the seed of these indigenous crops for farmers in the rural communities with similar improved crop varieties, such as groundnut and cowpea, farmers were supported by the NSBCP to establish *in-situ* seed multiplication fields (Figs. 7–11). Selected farmers were assisted with funding for labor in order to increase the production of the indigenous cereal and legume crops so as to provide a source of seeds for the local communities. Other farmers, who lived within or outside the community, could obtain the cultivated seed from these assisted farmers.

Table 4 shows the regional average yields of some major crops cultivated by farmers in the Upper West Region. Sorghum, millet, rice, groundnut and cowpea are among the seven crops selected by MOFA as major crops cultivated in the region (sorghum, maize, millet, rice, groundnut, cowpea, and yam), and yields of these crops are calculated and recorded annually. Bambara groundnut and Kersting's groundnut are not included in these selected crops, which might explain the state of neglect of these crops compared to the major crops despite their contribution to the food supply in rural communities. The lower yields of the crops shown in Table 4 could be due to indigenous crop cultivars being used as seeds in rural farming communities in the region. Sorghum, millet, and rice seeds are primarily from indigenous crop cultivars compared to maize and cowpea crops. Both indigenous and improved groundnut seeds are used by farmers to a wider scale, unlike the bambara

Table 3–2. Sorghum (*Sorghum bicolor* [L.] Moench)

Farmer's Age (Years)	Community	District	Variety Name (Local Name)	Days to Maturity
57	Liero	Sissala	Dawale-Zie	120
57	Taffiasi	Sissala	Kadaka	120
35	Taffiasi	Sissala	Kadaka	120
50	Taffiasi	Sissala	Kadaka	120
43	Lilixsie	Sissala	Kpalfiemie	150
75	Nanchala	Sissala	Gbaffullo	150
58	Bujan	Sissala	Kanton-nii	150
60	Bujan	Sissala	Mifianmie	150
75	Nimoro	Sissala	Zelfieme	150
63	Jeffesi	Sissala	Delfieme	120
42	Nanchala	Sissala	Mempeh	150
60	Tarsor	Sissala	Mempeh	150
48	Gowi	Sissala	Mempeh	150
42	Lilixsie	Sissala	Mempeh	150
36	Gaapari	Sissala	Mempeh	150
53	Taffiasi	Sissala	Nyoso	120
47	Tarsor	Sissala	Nyoso	120
53	Dimajan No. 2	Sissala	Nyoso	120
60	Pulma	Sissala	Nyoso	120
56	Nanchala	Sissala	Cheteh	180
54	Nankpawie	Sissala	Cheteh	180
49	Dimajan No. 2	Sissala	Cheteh	180
57	Dimajan No. 2	Sissala	Cheteh	180

Table 3–3. Pearl millet (*Pennisetum glaucum* [L.] R. Br.)

Farmer's Age (Years)	Community	District	Variety Name (Local Name)	Days to Maturity
65	Sawale	Jirapa/Lambussie	Zibile	90
56	Billaw	Jirapa/Lambussie	Nyun-Halla	150
40	Bikyiinteng	Jirapa/Lambussie	Zikabulo	180
57	Brifoh-Cha	Lawra	Zikpee	180
56	Badi-Zambo	Lawra	Zisogla	150
62	Badi-Zambo	Lawra	Zibile	90
49	Paase	Wa	Zibile	90
58	Charia	Wa	Waali	150
49	Nankpawie	Sissala	Waali	150
35	Nimoro	Sissala	Nyun-Halla	150
40	Nimoro	Sissala	Mipulma	120
49	Taffiasi	Sissala	Mipulma	120
50	Taffiasi	Sissala	Mipulma	120
55	Tarsor	Sissala	Mipulma	120
40	Jonga	Wa	Jibile	90

Table 3-4. Rice (*Oryza glabberima* Steud.)

Farmer's Age (Years)	Community	District	Variety Name (Local Name)	Days to Maturity
62	Kumasaal	Lawra	Munkpee	180
32	Tanchara	Lawra	Munkpee	180
58	Betaglu	Lawra	Dagara-mune	120
53	Tanchara	Lawra	Mun-neri	120
40	Kokoligu	Lawra	Chichi-efor	150
39	Gbantankure	Lawra	Tikilah	90
75	Bihee	Wa	Mukazie	120
45	Polee	Wa	Muikajie	90
48	Sombo	Wa	Muijie	90
47	Liero	Sissala	Muizie	90
35	Nimoro	Sissala	Gongo-muni	90
52	Liero	Sissala	Mui-pila	150
35	Nimoro	Sissala	Mimpummu	150

Table 3-5. Cowpea (*Vigna unguiculata* [L.] Walp.)

Farmer's Age (Years)	Community	Variety Name (Local Name)	District	Days to Maturity
65	Sawale	Jirapa/Lambussie	Bensoglaa	75
53	Karni	Jirapa/Lambussie	Lamuraa	75
51	Samoa	Jirapa/Lambussie	Sobino	90
54	Karni	Jirapa/Lambussie	Beng-gber	120
45	Tanchara	Lawra	Bibirtakone	55
35	Tanchara	Lawra	Bibirtakone	55
75	Tanchara	Lawra	Bibirtakone	55
50	Kokoligu	Lawra	Bibirtakone	55
60	Ko	Lawra	Benkpee	120
58	Zambo-Hayieu	Lawra	Wentelle	60
55	Manwie	Wa	Bensoglaa	75
60	Loggu	Wa	Bensoglaa	75
42	Boli	Wa	Bensoglaa	75
75	Chaggu	Wa	Bengberi	120
58	Jingo	Wa	Biihibawala	90
34	Dimajan No.2	Sissala	Bondabine	90
48	Lilixsie	Sissala	Bondabine	90
76	Deribelle	Sissala	Bondabine	90
54	Liero	Sissala	Bengbaare	90
55	Kulfuo	Sissala	Sonkajintia	150
43	Lilixsie	Sissala	Bondafieng	90

Table 3–6. Groundnut (*Arachis hypogaea* L.)

Farmer's Age (Years)	Community	District	Variety Name (Local Name)	Days to Maturity
52	Samoa	Jirapa/Lambussie	Sinkan zasollo	120
60	Karni	Jirapa/Lambussie	Sinkaa kpolo	120
60	Yagha	Jirapa/Lambussie	Sinkaa kolomoh	120
45	Tanchara	Lawra	Sitelkele	120
52	Zambo-Hayieu	Lawra	Tekelle	90
55	Tanchara	Lawra	Bobonaanyine	120
60	Betaglu	Lawra	Siiminga	120
60	Zog-Pieli	Lawra	Sibongni	120
38	Ko	Lawra	Bie-tar	90
69	Dowemi	Lawra	Dagasinkaan	120
75	Boo	Lawra	Sinkankpong	120
85	Charia	Wa	Wiiri	120
80	Sagu	Wa	Mwolii/weetii	150
70	Bihee	Wa	Walgyanuhu	120
25	Tarsor	Sissala	Sunkponwoko	90
45	Nankpawie	Sissala	Dagomba	120
56	Liero	Sissala	Sinkaan-menga	120
80	Kuntulo	Sissala	Kayane	90

Table 3–7. Bambara groundnut (*Vigna subterranea* [L.] Verdc.)

Farmer's Age (Years)	Community	District	Variety Name (Local Name)	Days to Maturity
35	Karni	Jirapa/Lambussie	Simisoglaa	90
64	Tampaala	Jirapa/Lambussie	Sinkpone	120
60	Bikyiinteng	Lawra	Sankum-sigbilkpee	90
46	Ko	Lawra	Bankaragyle	120
55	Kumasaal	Lawra	Bankarbile	90
55	Tanchara	Lawra	Siigbilkaali	150
67	Boo	Lawra	Dapialikamu	120
70	Jonga	Wa	Sumbikpong	120
67	Nankpawie	Sissala	Mouli	120
60	Pulma	Sissala	Sinkongo	90
47	Taffiasi	Sissala	Simmie	120
70	Nankpawie	Sissala	Simpulun	65
82	Bujan	Sissala	Sinkon	120
56	Nimoro	Sissala	Kantonsibii	120

groundnut and Kersting's groundnut, which are only available to farmers as landrace cultivars.

The mean dry grain yields of the three different seed colors of Kersting's groundnut (Fig. 12) for the 2005 and 2006 cropping season are shown in Table 5. The black-seeded Kersting's groundnut under farmers' field practices showed the highest mean dry grain yield, 250 kg/ha. In comparison, the white-seeded and mottled seeded varieties yielded 178 kg/ha and 124 kg/ha, respectively, under

Table 3–8. Kersting's groundnut (*Macrotyloma geocarpum* Harms.)

Farmer's Age (Years)	Community	District	Variety Name (Local Name)	Days to Maturity
59	Boo	Lawra	Susuoli	150
54	Boli	Wa	Sunsuonii	150
48	Nakori	Wa	Sunsuonii	120
39	Manwie	Wa	Sinsuonii	150
66	Dangi	Sissala	Sinsuonu	120
50	Nimoro	Sissala	Sinsuonu	150
67	Nankpawie	Sissala	Sinsuonu	120
47	Lilixsie	Sissala	Sinsuonu	150
48	Kulfuo	Sissala	Sinsuonu	150

Fig. 7. Collected indigenous sorghum crop under seed multiplication at the Poyentanga demonstration and multiplication garden, near Wa, Ghana.

Fig. 8. Indigenous pearl millet in a conservation field of a grant-supported farmer at Sawale in the Jirapa/Lambussie district of the Upper West Region, Ghana.

similar field practices. However, Buah and Huudu (2007) reported a mean grain yield of 1500 kg/ha for Kersting's groundnut (white, black, and mottled color seeds) cultivated in a tropical Savanna soil at Poyentanga near Wa District in the Upper West Region, using an inter- and intra-row spacing of 0.30 m and 0.20 m, respectively, under natural rainfall conditions. Stanley (2006) reported a mean grain yield of 628.1 kg/ha for mottled-seeded Kersting's groundnut in the Northern Guinea Savanna agroecological zone of Ghana under rain-fed conditions using 0.40-m and 0.20-m inter- and intra-row spacing, respectively.

Baudoin and Mergeai (2001) reported a mean grain yield of 500 kg/ha for Kersting's groundnut using inter-and intra-row spacings of 0.30 m and 0.15 m, respectively, by small-scale farmers. Planting dates might account for the lower yields obtained by farmers in the three fields of the Kersting's groundnut (white, black and mottled), independent of the differences in locations (Boli, Lilixsie, and Nimoro communities) and weather conditions that occurred during the two cropping seasons. Noting the importance of the planting dates on legume crop yields, Richards *et al.* (1984) specified that planting dates should be between May and June for legumes, which are mostly grown for seeds in the Savanna agroecological areas.

Buah and Huudu (2007) reported higher grain yields for the white-, black- and mottled-seeded

Fig. 9. An indigenous cowpea crop intercropped in a sorghum field that was part of the grant-supported farmer at Lilixsie (Sissala district, Ghana).

Fig. 10. Indigenous bambara groundnut crop under seed multiplication at the demonstration and multiplication garden, Poyentanga, near Wa, Ghana.

Fig. 11. Indigenous groundnut crop under seed multiplication at the demonstration and multiplication garden, Poyentanga, near Wa, Ghana.

Fig. 12. The seeds of the white, black, and mottled Kersting's groundnut cultivated in the in the Upper West region of Ghana by the three grant-supported farmers.

Table 4. Mean yield (metric ton/ha) of major crops in the Upper West Region (2004–2006)

Year	Sorghum	Pearl Millet	Rice	Cowpea	Groundnut
2004	0.88	0.76	2.23	0.93	1.53
2005	0.96	0.78	0.86	0.78	1.42
2006	0.93	0.75	1.23	0.80	1.50
Mean	0.92	0.76	1.44	0.83	1.48

Source: Statistics, Research and Information Division, Ministry of Food and Agriculture, Ghana

Table 5. Yields (kg/ha) of Kersting's groundnut at different locations- (2005–2006)

Location	Seed color	2005	2006	Mean
Boli	White	188	168	178
Lilixsie	Black	213	286	250
Nimoro	Mottled	113	135	124

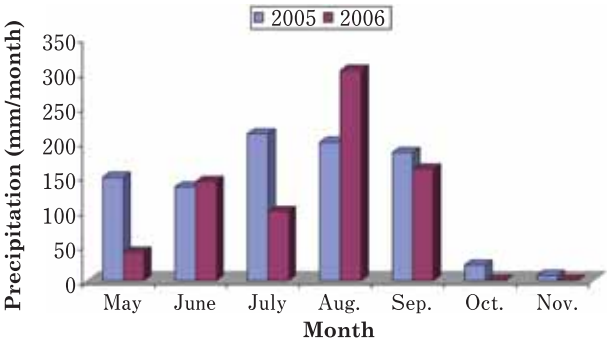

Fig. 13. The mean monthly rainfall for the Wa district, Ghana, over the 2005 and 2006 cropping season.
Source: Meteorological Service Department, Wa (Station 01013WA) Station.

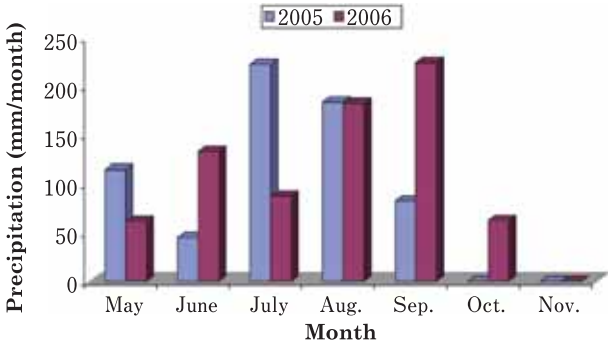

Fig. 15. The mean monthly rainfall for Sissala district, Ghana, over the 2005 and 2006 cropping season.
Source: Meteorological Service Department, Tumu Station.

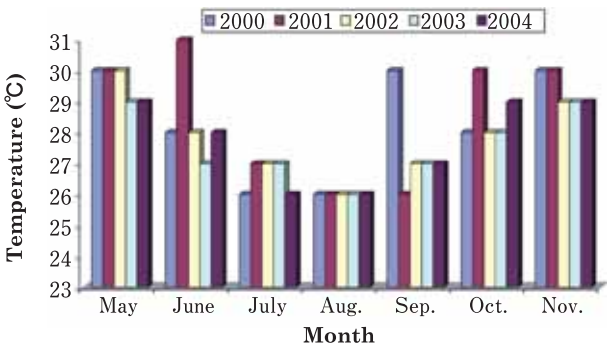

Fig. 14. The mean monthly temperatures for Wa district, Ghana, showing the trend over the 2000 to 2004 cropping seasons.
Source: Meteorological Service Department, Wa (Station 01013WA) Station.

Kersting's groundnut sown in June 2005 and 2006 at Poyentanga near the Wa district of the Upper West Region of Ghana in the Guinea Savanna agroecological zone. All three colored seeds used for the row spacing research at Poyentanga came from the three selected farmers from the Boli, Lilixsie and Nimoro communities. Planting took place in the third week of June 2005 and 2006. The 2006 cropping season site was preceded by an indigenous sorghum crop. Three weeding regimes were carried out in all fields for 2005 and 2006. Row spacing of 0.30 m by 0.20 m was found to give the highest yield compared to the different intra-row spacing of 0.10, 0.15, 0.25, and 0.30 m. There was no notable significant difference in yield between the white-, black- and mottled-seeded Kersting's groundnut.

A higher yield was also reported by Stanley (2006), who claimed that Kersting's groundnut seed sown in June provided the highest grain yields compared to seed sown in July and August in the northern Guinea Savanna agroecological zone of Ghana under rain-fed conditions. The notable difference in yield could be explained by the difference in soil type and weather conditions. The genetic variability of the seeds might also be a contributing factor to the difference in yield. Differences in the planting dates could also account for the difference in yields. Seeds planted in June at Poyentanga yielded more than those planted in July, which

Table 6. Traditional farming practices used by the farmers

Activity	Description	Practice Date	
		2005	2006
Land preparation	Tractor disc-drawn plough	Jul 12th	Jul 14th
Sowing	2-3 seeds sown in stick dibbled holes (not in rows)	Jul 19th–25th	Jul 21st–25th
Weeding	One weeding by hand hoe	Aug 13th–26th	Aug 16th–26th
Harvesting	Dug with hoe to soften and hand pulled	Nov	Nov
Threshing	Heaped and left in field for 3 weeks and threshed with sticks	Dec	Dec
Winnowing	Manual winnowing	Dec	Dec
Storage	Seed are stored in clay barns, pots or plastic containers	Dec–Jan	Dec–Jan

Table 7. Yield (kg/ha) of Kersting's groundnut from *in-situ* conservation fields

Farmer's Name	Location	Seed Color	Field Size (m^2)	Yield	
				2005	2006
Mwamoa-Ma Gbolo	Boli	White	4000	188	168
Jalia Tangia	Lilixsie	Black	2000	213	286
Bakuoro Boutey	Nimoro	Mottled	2000	113	135

might be explained by the likelihood of the ability of the latter to might have achieved the optimum photosynthesis during the growth and development stages. This is in line with the conclusion of Pratley (1994), who claimed that legumes exhibit accelerated maturity, thereby shortening the vegetative and flowering stages, when sown at increased temperatures and day lengths.

Average monthly rainfall for the 2005 and 2006 cropping seasons in the Wa and Sissala districts and the mean monthly temperature for Wa are presented in Figures 13–15. Although the rainfall data provide a general indication of rainfall during these years, the data are not specific to the field locations. Erratic rainfall patterns may have occurred and affected crop yields of Kersting's groundnut. Seeds planted in June might have had an advantage over seeds planted later because of the availability of moisture in a general term in spite of the differences in locations and soil moisture retention properties.

Only one weeding was carried out, and this approach was used in all three fields after the third week of planting (Table 6). A single weeding effort probably only controlled weed competition and competition for nutrients around the Kersting's groundnut crop during the early growth and development stages of the groundnut. The random sowing method adopted by the farmers might have resulted in low plants population and thereby the canopy cover to the soil to minimize weed emergence became ineffective (Fig. 4). Donald (1963) stated that crop potential can only be achieved when there are no limitations to growth factors, such as light, nutrients, water, temperature, and favorable soil conditions. Farmers practiced a single weeding regime possibly because they preferred to allocate their labor time among other cultivated food crops, such as sorghum, maize, yam, and millet, which are considered more important.

Table 7 lists the three selected farmers supported by the NSBCP to establish *in situ* conservation fields for Kersting's groundnut in the Boli, Lilixsie, and Nimoro communities. This is an initiative taken by the NSBCP in collaboration with MOFA and SARI as the main implementers of a conservation strategy of the threatened, indigenous, neglected Kersting's groundnut seed in the Upper West Region of Ghana.

As part of the overall conservation strategy, food bazaars and exhibitions of the indigenous crops are promoted at major national, regional, and district festivals (Fig. 16). This is a public awareness campaign to demonstrate the usefulness of indigenous crop cultivars in the region.

Fig. 16. Food prepared from Kersting's groundnut is provided to the general public during a National Farmers Day celebration at Tumu in the Sissala district, Ghana. This was part of a strategy to create public awareness on the potential benefits of using indigenous crops.

There are several limitations to the interpretation of information from this study. Little is known about the genetic variability of the three different cultivars of the Kersting's groundnuts seeds that were used. Also, the fields were located some distance from each other and the seed crops were grown without replication; hence there was no control over the variation in soil type or environmental conditions.

Further studies should be conducted on the genetic variability of the three different cultivars of the Kersting's groundnut seeds. Research should also be carried out that includes many more farmers and with replicated fields. The results should help to generate area-specific recommendations for the farmers in the Upper West Region of Ghana.

4. Conclusion

The results of this study indicate that lower yields of Kersting's groundnut obtained by farmers in three locations (Boli, Lilixsie and Nimoro) could be attributed to farming practices that include a traditional late sowing in July and a single weed-control practice. Weeding once during the season might have resulted in increased competition between the Kersting's groundnut crop and weeds for available soil nutrients. The random sowing of seed in all three locations might have resulted in a more sparse plant cover with a decreased yield per unit area compared to the 0.30-m and 0.20-m inter- and intra-row spacing, respectively. I recommend that farmers in the Upper West Region plant Kersting's groundnut seed in June to obtain maximum yields of grain. Planting Kersting's groundnut seeds in an inter- and intra-row spacing of 0.30 m and 0.20 m, respectively, on tropical Savanna soils as a monoculture crop is recommended for farmers in the Upper West Region.

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