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Production Determinants of the Pearl Millet Cropping System in Uganda and Implications to Productivity

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Abstract

Pearl millet is an important crop for people living in semi-arid areas in Uganda but not much is known about its production environment. A survey was conducted in eastern and northern regions of Uganda to characterise the pearl millet cropping system and to identify the most important production determinants. Using questionnaires, data was collected from 160 households through face-to-face interviews with the respondents. Results showed that pearl millet was mainly grown for food and source of income. The production environment was low input as farmers planted unimproved genotypes, used no artificial chemicals or manure, and had minimal access to financial credit and agricultural trainings or extension services. Planting was done in the second rains with no optimal use of important resources like family labour and seed due to seed broadcasting. Farmers desired genotypes with traits such as; stay green, being tall, high tillering, high yield, early maturity and being ergot resistant. The most important constraints were ergot and rust diseases susceptibility, low yield, low tillering, late maturity, sterile panicles, rodents, moulds/rotting and insect pests; while lack of market, low prices and price fluctuation were the important market constraints. Results further showed that farmers lacked knowledge about the common diseases like rust and ergot. The area planted, spouse age and years of pearl millet cultivation were the important factors enhancing production while age of household head, amount of seed planted and distance to the market negatively affected grain yield.

Keywords: pearl millet, production determinants, desired traits, constraints, rural appraisal

1 Introduction

Pearl millet is the hardiest cereal (Reddy et al., 2012) and primary food for people in drought-prone areas of Africa (Ndjeunga & Nelson, 2005) and India (Roden et al., 2007). It is the sixth most important cereal in terms of cultivated area (Khairwal et al., 2007a). In India, it ranks fourth (Yadav et al., 2011) while in Africa the ranking varies. It excels as forage (Basavaraj et al., 2010) and food (Vetriventhan et al., 2008). Nutritionally, it is better than the competing cereals like sorghum, maize, and rice in terms of proteins (Roden et al., 2007), fats, iron, energy and carotene (Singh et al., 1987). The various forms of use have particular standards set by users; forming a basis for developing varieties that have the desired qualities. However, until recently plant breeders had not involved pearl millet users when developing varieties with desirable characteristics; resulting in many varieties not being adopted by the intended beneficiaries (Ndjeunga et al., 2000). The low adoption may partially be explained by the poor seed supply system, production constraints and failure to meet desirable cooking qualities (Ndjeunga & Nelson, 2005). This implies that knowledge of traits preferred by the pearl millet beneficiaries and establishing constraints is important for designing an effective breeding strategy. However, appropriate approaches should be adopted in order to effectively characterise the production environment. Participatory rural appraisal techniques have successfully been used to characterise the production environment of many crops; leading to identification of desirable features and production constraints. Informal appraisal techniques corroborate formal techniques in elucidating relevant local knowledge (Mergeai et al., 2001). Through participatory surveys Brocke et al. (2003) established farmers' selection criteria of new pearl millet varieties based on adaptability and productivity while Weltzien et al. (1998) showed that farmers were important in the evaluation of new pearl millet varieties before release. Paris et al. (2008) showed that integration of gender issues in participatory research was important in varietal selection and dissemination while Camara et al. (2006)

successfully adopted participatory rural appraisals to assess the impact of sorghum and millet research. Paris et al. (2008) also noted the importance of involving technology users at all technology development stages for increased technology adoption. In this study farmers' views were sought in order to design an effective breeding programme. This is important because scanty information about pearl millet research exists in Uganda. A participatory rural appraisal baseline study was conducted to establish pearl millet production determinants. The specific objectives included; 1) establishing the importance and utilisation of pearl millet, 2) assessing the extent to which improved inputs and improved technologies were used to increase productivity, 3) highlighting the agronomic factors, 4) identifying farmers' desirable and undesirable, 5) establishing production and marketing constraints and 6) identifying the most important determinants of production.

2. Methodology

2.1 Study Area and Households Selection

A baseline survey was conducted in January 2012 in the eastern and northern regions in Uganda. Both regions are characterised by rearing of cattle and production of annual crops and having mainly sandy soils (Ronner and Giller, 2013). The eastern region has a bimodal rainfall pattern with long dry seasons while the northern region has a less pronounced bimodal rainfall pattern (Mwebaze, 2006). In the east the study was conducted in Kumi (01°30′N, 033°57′E, 1138 masl, 1270 mm rainfall) and Katakwi (01°54′N, 034°00′E, 1107 masl, 1270 mm rainfall) districts covering 80 households. In the north Kitgum (03°13′N, 032°47′E, 969 masl, 1130 mm rainfall) and Lamwo (03°32′N, 032°48′E, 1100 masl, 1130 mm rainfall) districts were covered involving 60 households. A purposive selection was done where only households that had grown pearl millet for at least one year were selected to participate in the survey. A five-stage stratified selection criteria was adopted in order to identify respondents. The strata were 1) cropping system, 2) district, 3) sub-county, 4) village, and 5) respondents.

2.2 Data Collection and Analysis

Data were collected through transect walks, problem listing and ranking (Lelo et al., 1995) which were corroborated by household formal interviews using semi-structured questionnaire. Informal data collection techniques like observations were adopted in order to better understand the pearl millet cropping system at the household level. The household crop and animal productivity was estimated using the 'farmer recall' (Smale et al., 2010) and 'prediction' methods (Singh, 2003). Data analysis was done using the statistical package for social scientists version20 (IBM-SPSS, 2011) and descriptive statistics were used to identify general patterns (Pender et al., 2002).

3. Results

3.1 Importance and Utilisation of Pearl Millet

Pearl millet was ranked fourth after cassava, sesame and groundnuts respectively; and being more important than sorghum, maize, finger millet green gram and sweet potato. The rank was an average of the rank as a 'food crop' and as a 'source of income'. However, the rank was dynamic due to changes in; palatability, being source of income, marketability, readily being accepted as food, land availability and change in family size. Percentage household response for pearl millet uses indicates that the grain was mostly used as food (44%), source of income (36%) and in brewing as yeast (17%). To a lesser extent grain was bartered for other food commodities or fed to poultry while stover was fed to livestock. Bartering the grain for other food stuffs was one of the coping strategies for using pearl millet as food security crop. As food, pearl millet was consumed as whole grain (not decorticated) pounded to make flour, which was then used to make either porridge or whole grains boiled. The pearl millet flour is also mixed with cassava flour and tamarind to improve on the taste.

3.2 Use of Improved Inputs and Improved Technologies

The Figure 1 shows that all households in the north planted unimproved seed while only 8% of those in east planted improved materials. The seed was either saved from previous harvests or bought from local markets (Figure 2). The most important reason for planting local unimproved varieties was lack of alternative seeds.

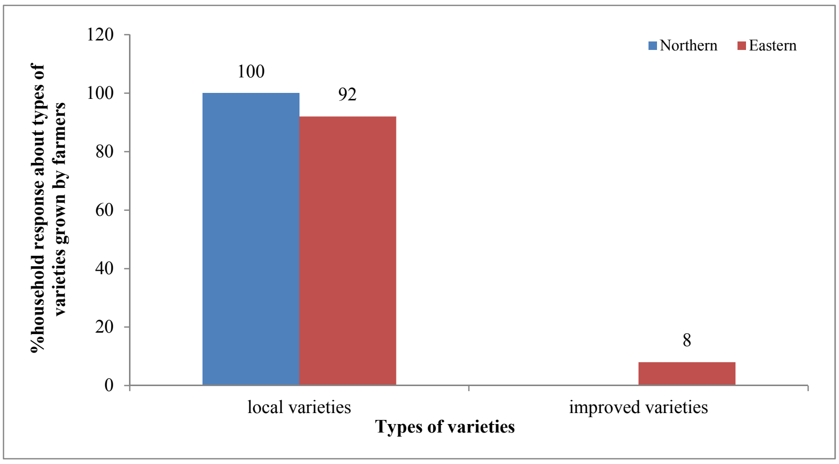

Figure 1. Types of planting materials grown by farmers

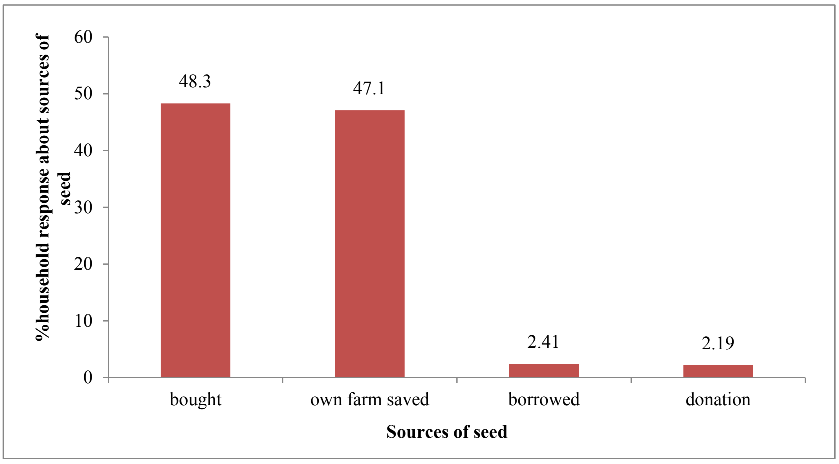

Figure 2. Common sources of pearl millet seed

Response about use of improved technologies like fertilisers, manure, herbicides, pesticides and soil and water conservation measures showed that majority (96%) of the households did not use the inputs mentioned to enhance pearl millet yield. They relied on inputs like unimproved seeds, family labour with minimal access to social services like agricultural trainings, extension services and rain water.

Figure 3 shows that the majority of the respondents did not have access to important social services which would enhance productivity. More than 86% did not keep financial and production records while more than 84% did not have access to financial credit. In addition, more than 55% did not have access to extension services or agricultural training nor were they members in any community groups that enhance social capital.

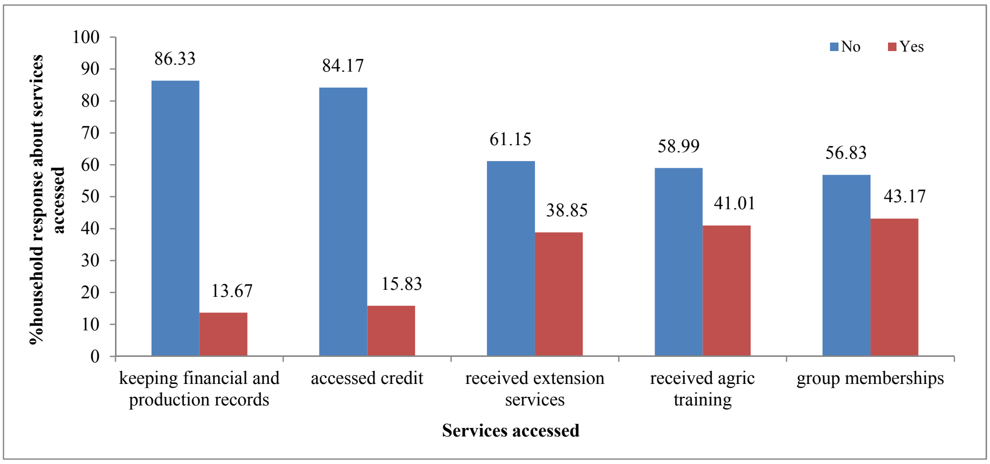

Figure 3. Services accessed by farmers

3.3 Agronomic Factors

Results in Figure 4 show that men were mostly involved in land preparation and planting, while women were more involved in weeding, harvesting and threshing. The main task for children was bird scaring. The households practiced mainly the sole cropping system and seed broadcasting as the mode of sowing (Figure 5). During planting farmers may either first broadcast the seed in a weedy field and later plough or they first ploughed and then sowed the grain. The quality of fields determined how often and soon weeding was done but in this case majority (74.10%) weeded only once. However, because most farmers (92%) planted pearl millet in the second rainy season, weeds may not be too much of a problem since normally less rainfall is received in that season.

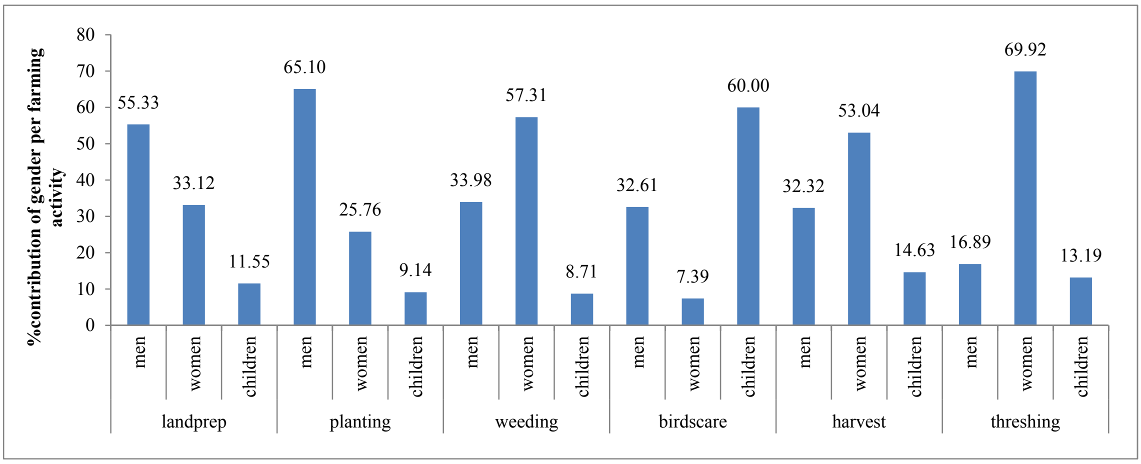

Figure 4. Farming activity by gender

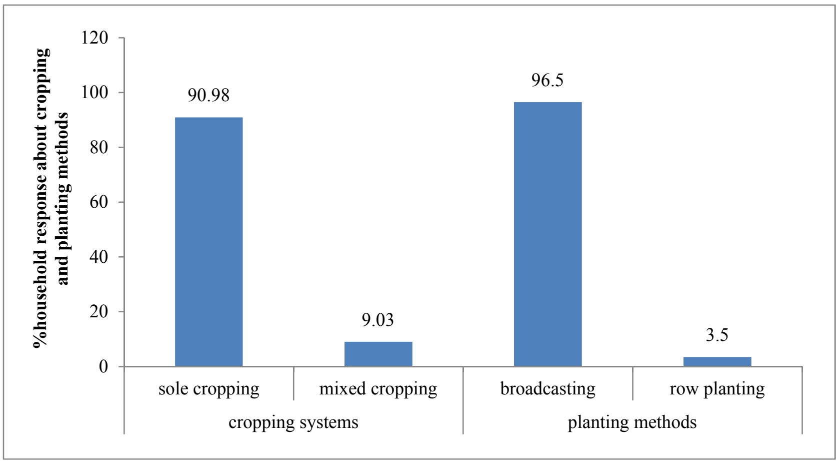

Figure 5. Cropping systems and planting methods

The desirable traits were stay green, being tall, high tillering ability, high yielding, early maturity and ergot resistance (Figure 6); while majority of the households reported ergot susceptibility as the most undesirable trait followed by varieties being short and susceptibility to rust (Figure 7). Low tillering ability, late maturity and sterile panicles also ranked high among the undesirable traits, especially in the northern region. Other less important undesirable characteristics are also shown in Figure 7.

Farmers described the preferred ideotype pearl millet plant as one that was ergot resistant, high yielding varieties with large white grains and early maturing. However, other important factors to consider should be; introducing appropriate pesticides and providing stable market for grain, training in fertliser/manure use, and developing non-itchy varieties (Figure 8).

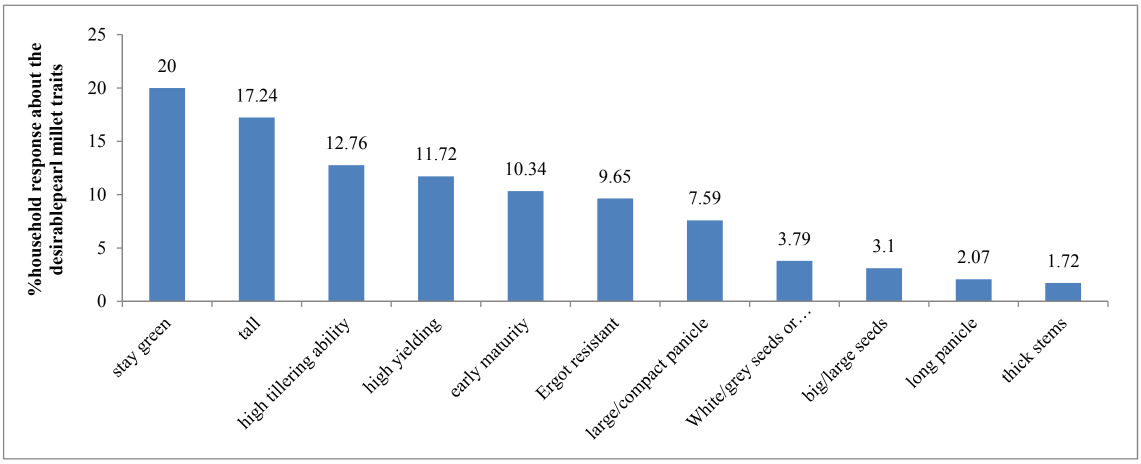

Figure 6. Desirable pearl millet traits

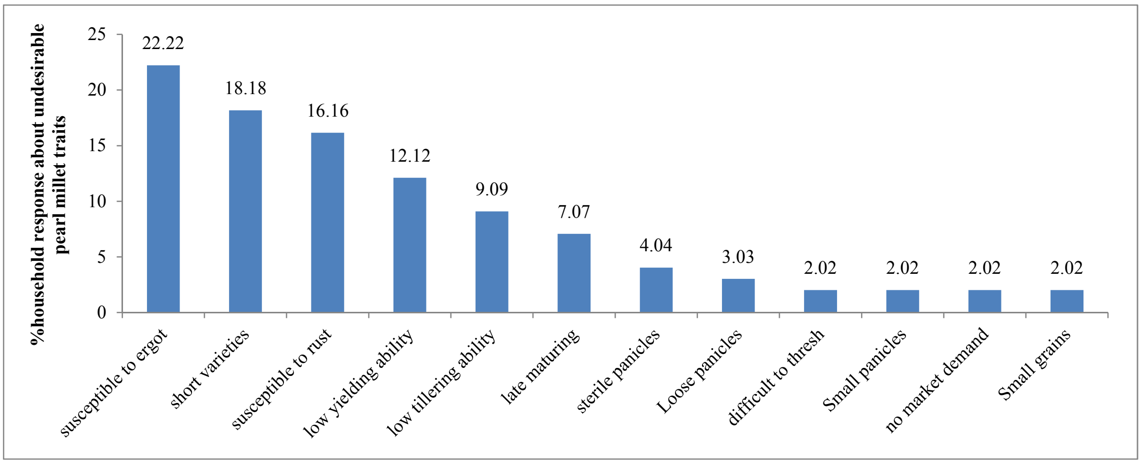

Figure 7. Undesirable pearl millet traits

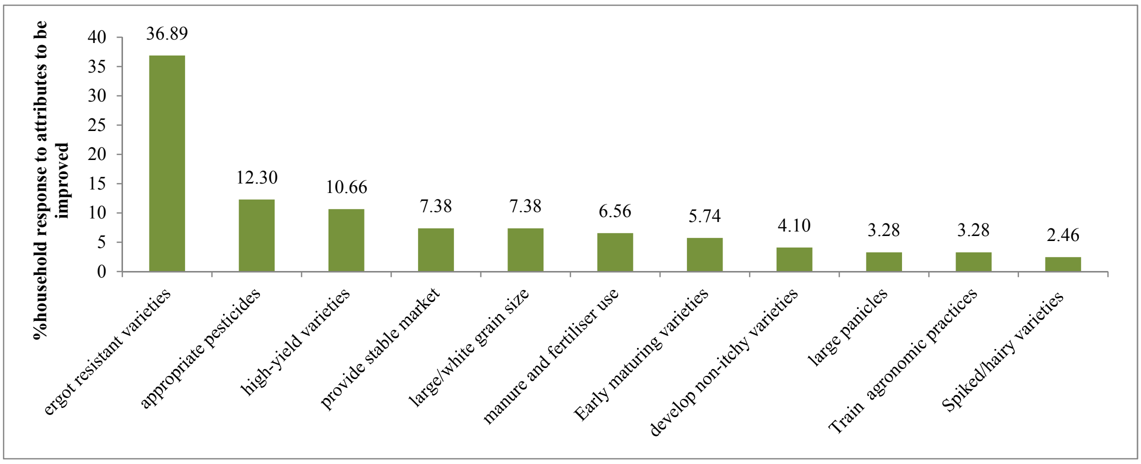

Figure 8. Pearl millet attributes to be introduced or improved

3.4 Pearl Millet Production and Marketing Constraints

Fig 9 indicates that ergot (*Claviceps fusiformis*) was the most important field production constraint (33%) followed by birds, weeds (not striga), rust and insect pests. Other field constraints included; low yield, animal destruction, drought and itching during field operations. In the field it was observed that smut was another disease affecting pearl millet but not mentioned by farmers. Although rust was ranked fourth, majority of (77%) of the farmers confessed to not knowing the symptoms of the disease, while 10% made a wrong diagnosis. Results further showed that ergot and insect pests were more prevalent in northern region especially in Kitgum district whereas in the east they were more prevalent in Katakwi district than in Kumi district. Birds and weeds were reported mostly in the east than in the north.

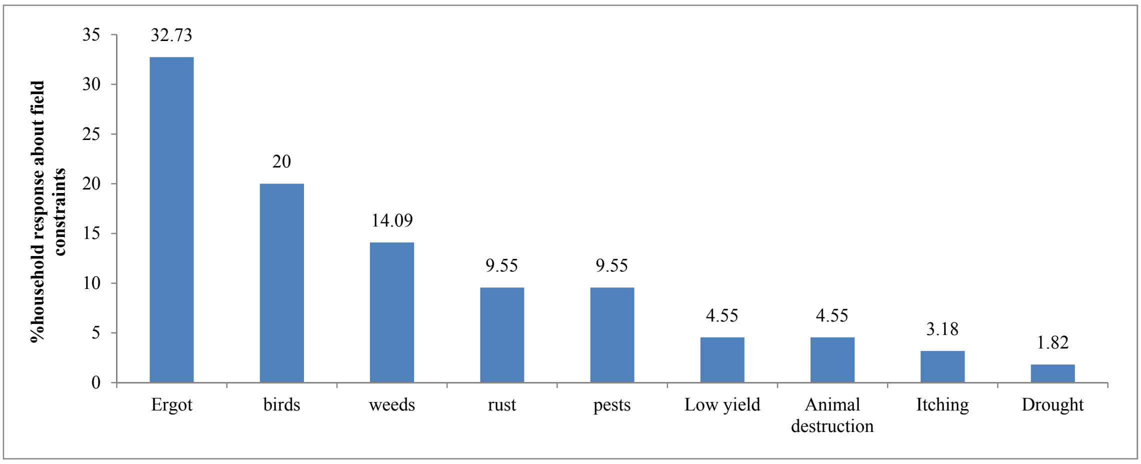

Figure 9. Pearl millet field production constraints

The majority (66%) of the farmers had no control strategy for ergot while 34% planted late in the second season to control the disease and birds. Crop damage by birds was ranked as the second most important field constraint destroying pearl millet at all grain development stages. The Quelea quelea birds were destructive at milk stage while the weaver birds destroyed the crop at all grain development stages. Most farmers had no control over the birds although some claimed that planting in the second rains minimised their effect. Early weeding was noted as the best control strategy against weeds whereas farmers had no control measures against rust and insect pests.

Household response about storage constraints showed rodents (36%) as the most important storage constraint followed by rotting/moulding and insect pests. Most households (38%) used poison to control rodents while many used traps (31%) and others (31%) did nothing to control rodents. Most households (67%) controlled rotting and moulding by proper drying of the grain before storage while 20% sold their grain produce as soon as it was threshed and 13% had no control strategy. Other constraints with no control strategy included; insects (especially termites and ants), weevils and moths.

Households indicated lack of markets (29%), low prices (18%) and price fluctuation (17%) as the most important market constraints. Other constraints were; far away markets, high transport costs and poor road conditions. Possible solutions to the major marketing constraints were suggested (Table 1). Some farmers suggested government intervention by fixing prices for pearl millet annually (40%) and carrying out market research to create more markets for the produce in addition to forming farmer groups for collective marketing. However, majority of the farmers had no idea (54%) on how to control the high market taxes although a few suggested carrying out market research before imposing the market taxes. Still on lack of transport to markets, majority of the farmers had no idea on how to fix the constraint but 31% suggested provision of bicycles at reduced prices and promoting buying on-farm to minimise the need for transportation to markets. About lack of markets for pearl millet grain produce, majority (47%) of the farmers suggested carrying out market search to create more markets for pearl millet although still many had no idea on how the constraint could be managed. Some farmers suggested longer storage of produce till good market is got. The solution to cheating by unscrupulous middlemen could be solved by using well calibrated weighing scales standardised by Uganda National Bureau of Standards (UNBS) but still the rest had no idea on how to solve the constraint.

Table 1. Percentage of households that responded about possible solutions to market constraints

Market constraints	Responses									
	No idea	Carryout market research	Gov't should fix prices annually	Road repairs needed	Using UNBS calibrated weighing scales	Providing bicycles at reduced cost	Promote buying on-farm at good prices	Form farmer groups for collective marketing	Open nearby markets in villages	Storage of produce for longer periods
Low prices for produce	28.00	16.00	40.00	4.00	0.00	0.00	2.00	10.00	0.00	0.00
High market taxes	53.85	46.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lack of transport to markets	34.62	0.00	0.00	0.00	0.00	30.77	11.54	3.85	19.23	0.00
Lack of market	41.67	47.22	2.78	2.78	0.00	0.00	2.78	0.00	0.00	2.78
Unscrupulous middlemen	20.00	0.00	0.00	0.00	80.00	0.00	0.00	0.00	0.00	0.00

3.5 Important Quantitative Production Determinants of Pearl Millet

Means of age of spouse, seed amount, area planted, distance to land cultivated with pearl millet, person hours, distance to the nearest market, education experience of household head and spouse, household population, pearl millet production experience and walking time to the market were modeled to identify the most important determinants of grain yield. The statistical test showed that the factors significantly ($p < 0.05$) affected grain yield (Table 2). However, a stepwise reduced model (Table 3) showed that area planted to pearl millet, distance to market, pearl millet production experience (years), seed amount planted, age of household head and age of spouse were the important determinants. The coefficient of determination (R^2 = 26.4%) showed that the model accounted for less than 27% of the variation observed; an indicator that other factors not accounted for in the model may also contribute to variation in grain yield. These may include agronomic issues, desirable traits, undesirable traits, constraints and qualitative factors affecting utilisation.

Table 2. Analysis of variance for the reduced model

Source of Variation	DF	Sum of squares	Mean squares	F-value	P-value	%R2	%AdjR2
Regression	5	1106.27	221.25	9.11	.0001**	26.4	23.5
Residual	127	3083.62	24.28				
Total	132	4189.89					

Note. *: significant at α = 0.05; **: significant ≤ 0.01.

Table 3. Most important quantitative determinants in pearl millet production

variable	Coefficients	Standard. error	t-value	P-value
(Constant)	2.417	3.593	0.673^{ns}	0.502
Area planted (ac)	9.05	1.768	5.118**	<0.001
Age of spouse (years)	1.164	0.537	2.169*	0.032
Years of pearl millet growing	1.056	0.388	2.724*	0.007
Distance to market (km)	-0.424	0.145	2.925*	0.004
Seed amount (kg)	-0.21	0.009	-2.277*	0.024
Age of household head (years)	-1.548	0.531	-2.917**	0.004

Note. Testing done at α = 0.05; *: significant ≤ 0.05; **: significant ≤ 0.01; ns = non-significant p > 0.05.

4. Discussion

4.1 Importance and Utilisation of Pearl Millet

Indirect indicators of pearl millet importance that may affect production included; rank relative to other crops, and change in importance with time. Being the fourth most important crop and its demand projected to increase further emphasises the importance of pearl millet to the farmers. This is because it is a food security crop with diverse uses. Farmers noted that pearl millet was a food security crop partly because it was drought tolerant; a reason why it was grown in the drought-prone areas in Uganda. The same applies to other countries where the crop is grown. For example in southern Africa, pearl millet is the most important cereal in the hot zones of Namibia (Rohrbach, 2000) and also the most important in the Sahel countries like Niger while in India it is grown on fringes of the Thar desert (Vadez et al., 2012). This makes pearl millet indispensable and the most important cereal in the dry areas (Reddy et al., 2012).

In developed countries pearl millet is used as mulch, forage and ingredient in animal feed industries (Basavaraj et al., 2010). However, in developing countries the crop is used for food and the stover is fed to livestock (Kelley et al., 1996) or used for building or fuel for cooking (Vetriventhan et al., 2008). Like in other developing countries, in Uganda the crop is also used for food and stover is fed to livestock while grain is sometimes fed to poultry. Unlike in other developing countries, pearl millet is neither utilised as building materials nor fuel for cooking in Uganda. The grain also has diverse uses as food in Asian countries like India, unlike in Uganda where use is limited. Thus, diverse use of pearl millet should be explored to promote wider adoption.

4.2 Use of Improved Inputs and Technologies and Access to Social Services

Improved seed, source of seed, access to improved inputs like fertilisers, pesticides, herbicides, soil and water conservation technologies and access to social and cultural services may define the production environment (Soleri et al., 2002) and thus promote adoption of new technologies (Amarender-Reddy et al., 2013). Majority of the farmers in Uganda grew local unimproved genotypes with average grain yield of about 658 Kg ha^{-1}. Under comparable conditions this productivity is much higher than the 150-200 Kg ha^{-1} realised in Namibia (Matanyaire, 1996) or 300-400 Kg ha^{-1} harvested by many farmers in India (Khairwal et al., 2007b). However, under improved production environment (Yadav et al., 2011), farmers in Uganda would increase productivity if they grew hybrids or improved open pollinated varieties (OPVs). Under optimal production conditions hybrids perform better than OPVs, yielding up to 4000-5000 Kg ha^{-1} (Khairwal et al., 2007b). Having no access to improved varieties is another reason why farmers in Uganda continuously grow unimproved seed. Thus increasing access to improved seed would lead to increased productivity of pearl millet in Uganda. The seed should be bought from certified seed dealers and thus a proper seed distribution chain should be developed.

4.3 Agronomic Factors

Agronomic factors affected pearl millet production and productivity. In Uganda, the production environment is dominated by planting once in the second rains, sole cropping, seed broadcasting and weeding once. In the second season, there is always less rainfall when compared with the first rainy season. Proper time of planting is important in determining the pearl millet yield (Hancock and Durham, 2010) where planting in the first season would be the ideal time of the year to achieve high yield. However, farmers plant late in the second season to minimise the effect of ergot disease and birds but exposing the crop to drought and late season diseases and pests. Winkel et al. (1997) reported that drought negatively affected grain yield, number of grains per tiller, single grain mass, number of productive tillers and booting time. In addition, effect of insect pests and diseases is pronounced under drought conditions (Ali et al., 2013). Thus, to achieve maximum yield farmers should plant early for optimal soil fertility use (Deshmukh et al., 2009). Namara et al. (2005) reported that crop production systems had an effect on the rate of soil nutrient uptake. Latha and Singh (2003) observed that nitrogen and phosphorous uptake was higher in the sole cereal cropping system. In addition, yield advantage and improvement in soil nutrients have been reported in the pearl millet-legume cropping system where cluster been, cowpea and mung beans were components (Sarr et al., 2008; Singh & Joshi, 1994). Other beneficial legumes include; pigeon pea, green gram, soybean, groundnuts (Paraniappan & Sirivaman, 1996). However, in Uganda sole cropping system is practiced and as such no optimal use of soil nutrient is achieved, resulting in low yield. Thus beneficial cropping systems, especially cereal-legume, should be promoted in Uganda to achieve higher yield.

Sowing/planting methods also affect the pearl millet yield (Bakht et al., 2007). Farmers in this study adopted broadcasting method of planting. The method does not optimise grain yield compared with row planting (De Gautam & Kaushir, 1988). This is because under broadcasting there is uneven plant spacing which results in reduced number and size of panicles (Soman et al., 1987). In addition, it was observed in this study that broadcasting led to seed wastage since farmers planted 20 Kg ha^{-1} instead of the recommended 2-5 Kg ha^{-1} (Murty et al., 2007). Thus, farmers should adopt row planting to minimise seed wastage and to obtain higher grain yield (Fromme et al., 2010).

Weeding under broadcast planting method is done manually and thus labour-intensive (Klaij et al., 1996); one of the reasons why farmers in Uganda weeded pearl millet once in a season. However, higher grain yield is obtained when weeding is done more than once (Tenebe et al., 2012). Weeding once is not an effective control of weeds; the result is all yield components of pearl millet being negatively affected. The number of grains per panicle is the most severely affected component under weed infestation (Limon-Ortega et al., 1998). Thus, farmers in Uganda should practice adequate weed control, narrow row spacing, use of fertilisers in order to increase productivity.

4.4 Farmers' Desirable Traits and Undesirable Traits

Pearl millet genotypes are defined by traits which may be desirable or not (Ndjeunga & Nelson, 2000). In Uganda, the genotypes currently grown had desirable and undesirable traits. Among the desirable traits stay green was the most important trait followed by being tall, high tillering ability, high yielding and early maturity; all of which are related to drought tolerance. However, in countries like India, the order of importance differs; where high yield and good taste are the most important attributes for variety adoption (Asare-Marfo et al., 2010). High yielding ability, early maturity and large grains are among the traits with visual appeal (Khairwal et al., 2007a) used in plant breeding programmes to improve varieties (Rai et al., 1999). In this study these traits ranked fourth and fifth respectively; an indicator that farmers may not focus on yield *per se* but stability under high-risk environments as also noted by Haussman et al. (2010). This is reflected in the farmers' most desirable traits being related to drought adaptability. Same observation was made by Brocke et al. (2003) where farmers selected varieties with stable yield under stress conditions rather than those with high grain yield under favourable conditions. Thus breeding programmes should involve the target beneficiaries in problem identification in order to develop technologies for effective adoption.

4.5 Production and Marketing Constraints

The most important field production constraint was ergot disease followed by birds, weeds, rust and insect pests especially the stem borers, moths and red flour beetle. Ergot is also one of the most important diseases causing considerable yield loss in West Africa (Nutsuga et al., 2006). Being important calls for immediate attention because the ergot pathogen produces alkaloids that cause ergotism in humans and other animals when contaminated grains are consumed (Thakur & King, 1988). Smut and blast were other field constraints not mentioned by farmers but observed in the pearl millet fields (Lubadde et al., 2014). Drought negatively affected vegetative and reproductive growth stages of pearl millet thereby reducing grain yield (Maqsood & Azam-Ali, 2007) by more than 45% (Fussel et al., 1991). Radhouane (2013) reported that drought affected grain yield through reduction of number of grains per panicle, plant height and panicle weight. The yield components are also severely affected when drought sets in before and after flowering of the main panicle (Winkel et al., 1997). The probability that drought severely affected grain yield of pearl millet in Uganda is high because farmers always planted late as a coping strategy against ergot disease and birds, but predisposing the crop to drought. Thus drought may be one of the major factors reducing grain yield, a reason 'stay green' was their most desirable trait.

Birds affect pearl millet right from germination stage through milk stage to physiological maturity. In some Asian countries the Blue Rock Pigeon, House Crow and Grey Francolin are the most destructive at germinating stage (Patel, 2011). However, in many African countries (Ali et al., 2013) and in Uganda the *Quelea quelea ethiopica* is the most destructive bird affecting peal millet. In Uganda it destroys the crop at milk stage while the weaver bird affects the crop at soft dough and physiological maturity stages. The only coping strategy for bird control by farmers in Uganda is through planting late in the second rainy season because that is the time when alternative cereals like rice, finger millet and sorghum are also in the field so birds have choice.

Farmers did not emphasise insect pests as serious yield constraints and thus could not name any pest. However, through observation in the farmers' fields and stored grain, conclusion was made that stem borer, red flour beetle, grain weevils and Indian meal moth were the common insect pests affecting pearl millet. The stem borer is also one of the major pests in West Africa (Nwanze, 1991) and India causing significant grain loss to pearl millet while the red flour beetle and Indian meal moth cause significant losses in stored grain (Yadav et al., 2011).

The most important market constraints were lack of market for pearl millet grain, low prices and price fluctuation of grain respectively. Baba and Maina (2013) reported high transport costs as being the major constraint among traders but this constraint ranked low among the farmers in Uganda; implying that those involved in the value chain may have different constraints. Low prices for grain was identified as a major factor limiting the commercial viability of pearl millet in Africa and exploring larger markets was suggested (Rohrbach, 2000) as also expressed by findings in this study.

4.6 Modelling for Important Determinants of Production

All factors of production, except age of household head and distance to the markets, had a positive effect on grain yield. Area planted to pearl millet was the most important determinant of grain yield. The factor has also been reported as being important in determining agricultural profitability (Cornia, 1985) and technology adoption (Gabre-Madhin & Haggblade, 2001). Research findings by Feder et al. (1985) showed that farmers with large areas of land were likely to adopt advanced technologies such as irrigation although this may lead to decreased yield due to reduction in returns to scale (Cornia, 1985). On the contrary, majority of the farmers in this study generally had small areas of land cultivated to pearl millet which compares well with pearl millet farmers in other developing countries like Nigeria (Idrisa et al., 2012). This implies that they are less likely to adopt advanced technologies but most likely to operate profitably as noted by Nkonya et al. (2002) and Pender et al. (2004). Thus input-intensive or land-saving technologies may be the best alternatives to increase productivity (Yaron et al., 1992). This implies that technologies that increase productivity, such as fertilisers, should be promoted rather than those that encourage cultivation of more land; as is currently the practice in Uganda (Pender et al., 2002). In addition, Singh and Joshi (2008) reported that to get positive returns, the marginalised small scale farmers should mainly use family labour; which was the case in this study where family labour accounted for more than 76% of the labour used in pearl millet cultivation. The years of pearl millet cultivation by a household had a positive significant effect on grain yield. However, this may apply to the spouses but not the head of household as age of head of household had a negative effect on yield. To the contrary Mustapha and Dangaladima (2008) reported that years of pearl millet cultivation and age of the farmers were not important determinants grain yield in Nigeria.

Studies by Nkonya et al. (2005) showed the importance of distance from the homestead to the cultivated land and market had a negative and significant effect on the use of farm resources and crop productivity. Results in this study concur with the Nkonya et al. (2005) findings as distance to the market had a significant negative effect on grain yield while distance to the cultivated land had a negative effect though not significant. It implies that the further away the land for cultivation or the market the more farmers lose interest to grow the crop. Seed amount planted was important in determining grain yield but had a negative effect. This is because high seed rates result in high plant population which reduces number of tillers per plant (Newman et al., 2014). On the contrary, low seed rates result in high number of productive tillers (Newman et al., 2006); a component that contributes to high grain yield.

5. Conclusion

The study highlighted the pearl millet production characteristics in the eastern and northern regions of Uganda. The uses and rank relative to other crops indicate that pearl millet is important to the farmers. The crop is limited to use as food and source of income; with diverse use yet to be explored. However, the future for pearl millet is bright as farmers indicated continued cultivation as long as the production environment improves and market for grain is available. The production environment was typical of low input which does not lead to high productivity. Farmers hardly used modern technologies like improved seed, fertilisers, pesticide or any soil amendment strategy. The lack of a seed supply chain compels farmers to regularly plant unimproved genotypes, which are inherently low yielding and susceptible to ergot disease and drought. The low input environment, when combined with constraints and lack of a supportive social environment, leads to the observed low grain yield. In addition, the cultural myths attached to field disease constraints show that farmers did not have much knowledge about the diseases. Thus, farmers should be trained in disease identification. The social environment is also inhibitory to increased productivity because the farmers lacked access to credit, lacked training in keeping financial records, majority had no access to agricultural training or extension services; yet these aspects also enhance adoption rate of new technologies. Further, factors of production like area planted, production experience and age of spouses enhanced yield, while some important factors like family labour and number of people in household were not limiting. Thus creating a supportive environment like training farmers and increasing access to new technologies like improved seed and use of fertilisers would promote increased productivity of pearl millet in Uganda.

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