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ASSESSMENT OF COMMON BEAN CULTIVAR DIVERSITY IN SELECTED COMMUNITIES OF CENTRAL UGANDA

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ABSTRACT

Common bean (*Phaseolus vulgaris* L.) diversity has been nurtured by Uganda's farming communities and in return it has sustained their livelihoods for over 40 decades. Despite the farmers' invaluable effort in perpetuating this diversity, there is limited overall understanding of its status and dynamics on-farm. This study assessed the amount and status of the cultivar diversity in selected rural and peri-urban communities of central Uganda. Data were purposefully collected from 120 households through household surveys, focus group discussions and direct field observations. Diversity measures, status of the cultivars and morphological distinctiveness were estimated by Simpson's index of diversity (1-D), four cell analysis and cluster analysis, respectively. A total of 24 cultivars were observed in the whole study, and both communities had equal cultivar richness.There were no significant differences in the number of cultivars maintained by the farmers in the rural and those in the peri-urban communities. Both communities had substantial cultivar evenness (0.81 and 0.82 in rural and peri-urban, respectively), although only 19% of cultivars were grown on relatively larger areas and by many households. Impressively, at least 30% of the households in each community nurtured different sets of cultivars. We thus recommend the need to put in place incentive mechanisms that can encourage a section of the community to continue conserving *P. vulgaris* diversity on-farm to ensure its continued evolution and adaptation to changing biotic and abiotic factors.

Key Words: Distinctiveness, *Phaseolus vulgaris*, Simpson's index

RÉSUMÉ

La diversité du haricot commun (*Phaseolus vulgaris* L.) a été développé par des communautés de fermiers en Ouganda et, en retour, la culture a durablement contribué au bien être familial pendant plus de quarante ans. Malgré des efforts considérables des fermiers dans la perpétuation de cette diversité, la compréhension de sa situation et dynamique en champ reste limitée. Cette étude a évalué le nombre et la situation de la diversité des cultivars dans des communautés sélectionnées en milieux rural et péri-urbain de l'Ouganda central. Les données d'étaient collectées de façon raisonnée dans 120 ménages à travers une enquête de ménage, les groupes de discussions et des observations directes sur terrain. Des mesures de diversité, la situation des cultivars et la différenciation morphologique étaient estimées par l'index de diversité de Simpson (1-D), quatre analyses de cellules et l'analyse de groupes, respectivement. Un total de 24 cultivars était observé dans toute l'étude, et toutes les deux communautés avaient une richesse égale de cultivars. Aucune différence significative n'était trouvée dans le nombre de cultivars maintenu par les fermiers ruraux et péri-urbains. Les deux communautés avaient un nombre substantiellement invariant de cultivars (0.81 et 0.82 en milieu rural et péri-urbain, respectivement), malgré que 19% seulement des cultivars étaient cultivés relativement sur des vastes étendues et par plusieurs ménages. De façon impressionnante, au moins 30% des ménages dans chaque communauté avaient développé différents types de cultivars. Ceci démontre le besoin de mettre en place des mécanismes d'encouragement des communautés afin de continuer la conservation en milieux paysan de la diversité du *P. vulgaris* pour assurer son évolution continue et l'adaptation au changement des facteurs biotiques et abiotiques.

Mots Clés: Differenciation, *Phaseolus vulgaris*, Index de Simpson

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) was introduced in Africa before the 16th century, comprising two major gene pools; Andean (large seeded type) and Mesoamerican (small and medium-seeded type) gene pools (CIAT, 2001). Since then, common bean genetic diversity has sustained livelihoods and agro-ecosystems for more than 100 million people in Africa, with important economic and socio-political dimensions (CIAT, 2005). It plays principal roles in human nutrition and market economies throughout East Africa.

Jarvis and Hodgkin (2000) noted that through their management strategies, farmers make significant decisions that may affect the genetic diversity of crop populations and over time modify the structure of a population as farmers select for plants with preferred agro-morphological characteristics. Therefore, since its introduction in Uganda, farming communities have developed common bean diversity through selections and management of the biotic, abiotic, social and economic factors in their agro-ecosystems, resulting into a wide range of farmer varieties and populations. On the other hand, the national agricultural research system of Uganda has, over the last 43 years generated and released over 17 varieties into the farming communities, including new germplasm from the international research system. This, therefore, presents an enormous amount of genetic diversity in farming communities, whose conservation and optimal utilisation is based on deriving an understanding of its quantity and the associated dynamics.

In, Uganda, most of the work on the common bean has been revolving around developing high yielding, drought resistant, pest and disease tolerant cultivars. An understanding of the dynamics of the huge common bean diversity on-farm is, however, very limited. There is little information on the status of common bean diversity, the factors influencing its continued availability or possible genetic erosion on-farm. The consequences of climate change are likely to make the situation even more threatening to further the continued evolution, adaptation and the use of the adaptive traits of this diversity in crop improvement.

It is common knowledge, though, that improved varieties succumb to the ever changing biotic and abiotic factors, hence, the continuous need to develop new varieties. This is only possible through use of the huge genetic diversity that has evolved and acquired adaptive capacity to biotic and abiotic stresses in the agro-ecosystem.

The aim of this study was to assess the amount and distribution of the common bean diversity in rural and peri-urban communities of Central Uganda. The study evaluated the names and/or traits farmers use to distinguish the cultivars, the level of consistency and the extent to which these farmer-named units are morphologically distinct.

METHODS

This study was conducted in Mityana district located in the Lake Victoria crescent (0° 13' and 0° 41' N and between 31° 48' and 32° 16' E) in Uganda. Rainfall ranges between 1279 and 1524 mm per *annum*, with high periods in March to June, and August to November. Temperatures range from 15 to 28°C.

The study employed focus group discussions, household surveys, direct field observation and phenotypic characterisation as described below.

Data were collected from four sub-counties; two sub-counties from each county, i.e., Maanyi and Kakindu from Busujju county; and Busimbi and Kikandwa from Mityana county. The densely populated (157-207 persons Km^{-2}) sub-counties that were near the town council namely, Busimbi and Kakindu represented the peri-urban communities; while the sparsely populated (118-123 persons Km^{-2}) and distant sub-counties (Maanyi and Kikandwa) represented the rural communities. A community comprised at least four villages within the same agro-ecological system, sharing local markets and/or seed exchange system.

Purposive sampling by use of the snowball technique (Patton, 1990) was used to identify knowledgeable farmers maintaining a diversity of *P. vulgaris*. Based on this approach, coupled with the help of the agricultural extension workers of the study site, ten potential respondents were contacted and asked to identify all the knowledgeable farmers maintaining a diversity of *P. vulgaris* (i.e., at least two cultivars). From this, a list of 30 key informants was randomly generated to form the study sample.

Estimating cultivar diversity

Standardising of farmers' cultivar names. Consistency of cultivar names is essential for the proper analysis of diversity data (Jarvis *et al.*, 2008). Thus, prior to data collection from individual farms, focus group discussions were held with farmers from each of the study sub-counties. The focus groups were purposively selected to ensure fair representation of the parishes in the study sub-counties. The name each farmer gave to each cultivar, together with the traits he/she used to identify the cultivar in question were recorded. The names used by the different farmers, the sets of traits and the cultivar photos were used to arrive at the "basic diversity units" (Jarvis *et al.*, 2008).

The diversity units were based on agreement among farmers that the units at hand were different. The process called for removal of synonyms (i.e., two cultivars with different names that the farmers agree are actually the same items) and separating larger units into discrete units (i.e., two cultivars referred to with the same name by two or more different farmers but recognised as different units) (Jarvis and Campilan, 2006). These basic diversity units were used to estimate diversity in study sites. The cultivar names were given in 'Luganda' the ethnic language of the study area.

Estimating household cultivar diversity. Data on cultivar diversity were collected using key informant interviews guided by structured and semi-structured questionnaires. A total of 120 house-holds and farms (a farm was taken as the sum of all plots allocated to common bean cultivars; where a plot is a homogeneous portion owned by an individual farmer) were surveyed in the study; 30 households and farms from each sub-county.

From each house-hold, the number of cultivars (as identified by farmers) was recorded and the area of the plot allocated to each cultivar was measured using a GPS. Since the common bean is mostly (70-83.4%) grown as an intercrop, precise cultivar coverage was obtained from households growing the crop in relatively small sized plots while standardized area estimates were obtained from all inter cropped systems depending on the composition of the system.

Morphological distinctiveness of cultivars. The phenotypic diversity of *P. vulgaris* was studied both within a cultivar (among seed lots of a cultivar) and across cultivars (among sets of seed lots bearing different names). Using the seeds obtained during the focus group discussions and household surveys, all the 24 common bean cultivars identified in the study were planted in field trials at Namulonge Crop Resources Research Institute in October 2008. Following Duran *et al*. (2005), the cultivars were planted in a randomised complete block design with two replications.

The experimental units consisted of single 1 m row lengths for each cultivar and spacing of 0.5 m between rows, and 6cm between plants within rows, making a total of at least 20 plants per cultivar. From each cultivar, five plants per row were randomly chosen for the morphometric study. A standard *P. vulgaris* descriptor as provided by the International Plant Genetic Resources Institute (IPGRI, 2001) was used to obtain a total of eighteen morphological characters (14 qualitative and four quantitative) for a sample from each cultivar. The characters were: first flower days, plant type, leaf shape, flower colour of standard, flower colour of wings, veins in the standard, position of the pod on the plant, pod fibre hardness, fresh pod colour, mature pod colour, seed length, seed width,seed shape, 100 seeds weight, primary seed colour, secondary seed colour , seed coat pattern, seed coat luster.

Data analysis. Average farm richness was estimated as the average number of cultivars per farm. Total community richness was calculated by summing the number of distinct cultivars found across parishes in the community. The Simpson's index of diversity (1-D), being a measure of dominance was used as an estimate of evenness (Jarvis *et al.*, 2008). The index assumes that the common cultivars are reliably identified although it is relatively insensitive to the correct identification of rare cultivars (Magurran, 2003).Percentage divergence measured as the partition of diversity between and within farms was estimated as the difference between community and farm index values divided by the community Simpson index.

Following Rijal (2007), the status of the cultivars was analysed basing on their extent and distribution by use of the four cell analysis technique. This involved calculating the total area covered by each cultivar and the number of households growing it. Cultivars were then categorised into groups that occupied large (0.18 - 0.28 ha) or small (0.002- 0.11 ha) areas based on average area, and those varieties that were grown by many (at least 20 households) or few (ut most 5 households).The mean area in hectares per household, for each cultivar grown in a sub-county was calculated to determine whether a cultivar was grown in a large or small area.

Cluster analysis based on Gower's coefficient of dissimilarity, using average distance method (UPGMA), was performed using the BiodiversityR 2.6.1 (Kindt and Coe, 2005) software to reveal the structures from the morphological data. Principal Coordinate Analysis (PCoA) performed using the NTSYSpc (Numerical Taxonomy and Multivariate Analysis System version 2.1e; J. F. Rohlf, 2000) based on Simple Matching coefficient to derive the dissimilarities/similarities.

RESULTS

Farmer cultivar description and identification. Farmers distinguished common bean cultivars basing on seven agro-morphological traits; colour of mature seed, seed size, seed shape, seeds per pod, leaf colour, colour of mature pod, and main stem colour (Table 1).

Most farmers (71.0% in rural and 71.5% in peri-urban communities) used seed traits; colour, size and shape as the key distinguishing characters between and within cultivars. Most cultivar names (61.9 and 52.4% in rural and peri-urban communities, respectively) reflected seed colour. For similar seed colour, farmers used the seed size to differentiate cultivar names, for instance, 'Nambaale-omuwanvu' and 'Nambaale-omumpii' literarily meaning long Nambaale and short Nambaale, respectively. Other names were in honour of some leaders (e.g. Obote and MP in respect of former Head of State and Member of Parliament, respectively); while others were named after places where the seed originated from (e.g. Congo and Nambaale).

There were significant differences ($P< 0.05$) in the levels of consistency regarding cultivar identification among farmers, within and between communities. This was reflected by the variation in cultivar names and morphological features within and across the study areas. The lowest levels of consistency were mostly in the use of traits like number of seeds per pod, leaf colour, mature pod colour and main stem colour.

Morphological distinctiveness of cultivars. Both cluster analysis and PCoA showed the standardised farmers' names to be morphologically distinct units and were basically grouped into three. In both communities, and because the cultivar composition was alike, similar cultivar groupings were observed from cluster analysis and principal coordinate analysis. In cluster analysis, the cultivars were majorly grouped into two distinct groups A and B; with cluster A being the biggest with two sub-groups as presented by the dendrograms in Figure 1a and b. Results from the PCoA (data not presented) similarly grouped cultivars into three distinctive groups. The characters with the highest loadings were colour distribution, seed shape, pod shape immature pod colour, and flower wing colour.

The two sub-groups in cluster B were based on seed size and shape, with group A 1 being medium (1-1.5 cm) in size and oval in shape; while group A 2 consisted of mostly of large (1.6 - $\geq$2cm) seeded cultivars with a kidney seed shape. Group A1 comprised of Yellow-omumpi , Obumyufu

TABLE 1. The main distinguishing traits of the cultivars based on farmers' description in central Uganda

Cultivar name	Seed colour mature	Seed size(length)	Seed shape	Seeds /pod	Leaf colour	Pod colour (mature)	Main stem colour
Nakyewogola	Maroon with white speckles	Large (1.6 - ≥2cm)	Kidney	few (2-3)	Green	Cream with red and purple stripes	Purple and green
Obumyufu (A)	Red	Small (0.5-0.9 cm)	Round	very many (6-8)	Dark green	Purple	Purple
Obuddugavu	Small	Small	Oval	very many	Green	Yellow	Green
Yellow-omumpi	Yellow	Medium (1-1.5cm)	Oval	few	Green	Yellow with red stripes	Green
Kanyeebwa (A)	Pink with maroon speckles	Medium	Oval	many	Green	Yellow with red stripes	Green
Nkoolankubalire	Orange	Medium	Round	few	Light green	Yellow	Green
Khaki / MP	Cream	Small	Round	many (4-5)	Dark green	Yellow	Green
Obweru (A)	White	Small	Kidney	few	Green	Yellow	Green
Carolina	Red	Small	Round	very many	Green	Red	Red
Kifudu	Brown with white stripes	Medium	Oval	many	Green	Yellow with purple stripes	Green
Kanyeebwa (B)	Cream with red stripes	Medium	Oval	few	Green	Yellow with red stripes	Green
Nambaale-omuddugavu	Purple with white stripes	Large	Kidney	many	Green	Yellow with purple stripes	Green
Obumyufu (B)	Red	Medium	Round	few	Green	Yellow with purple stripes	Green
Namunye (L)	Cream with maroon stripes	Large	Kidney	few	Green	Yellow	Green
Obote	Black with white speckles	Large	Kidney	few	Green	Yellow with red stripes	Green
Mutikke-omumyufu	Red	Large	Kidney	few	Green	Yellow	Green
Obumyufu (C)	Red	Medium	Kidney	few	Dark green	Purple	Red
Nambaale-omumpi	Calima	Medium	Oval	many	Green	Yellow	Green
Nambaale-omuwanvu	Calima	Large	Kidney	many	Dark green	Yellow with red stripes	Green
Yellow-omuwanvu	Yellow	Large	Kidney	many	Green	Yellow	Green
Obweru (B)	White	Medium	Round	few	Green	Yellow	Green
Mutiike-purple	Purple with white speckles	Large	Kidney	many	Green	Yellow with red stripes	Green and pink
Namunye (M)	Brown with maroon stripes	Medium	Round	many	Green	Cream	Green and pink
Congo	White	Large	Kidney	many	Green	Yellow	Green

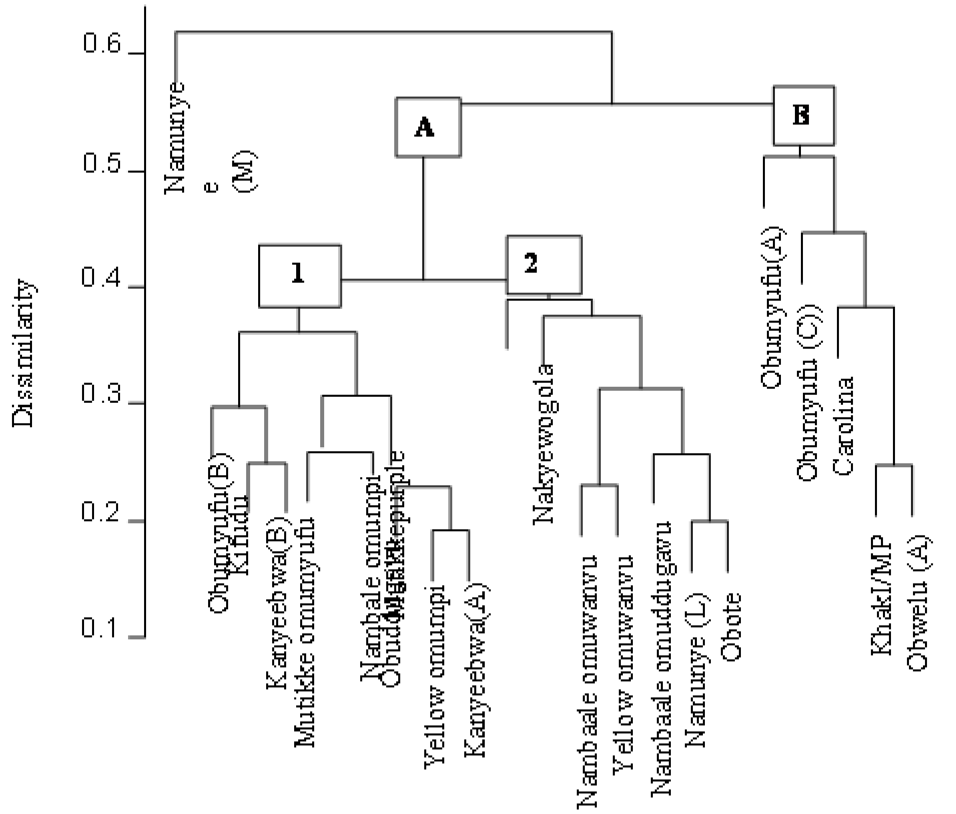

Figure 1a. Dendrogram pruned to show major clusters of UPGMA of Gowers' coefficient based on 18 characters and 105 individuals of common bean cultivars in the rural communities of Mityana, Uganda (Mantel statistic r: 0.8436 significance level: 0.001, based on 999 permutations).

(B), Nambaale-omumpi, Kanyeebwa (A), Kanyeebwa (B), Obuddugavu and Kifudu; while group A2 consisted of Obote, Mutiike-purple, Nambaale-omuwanvu, Nakyewogola, and Nambaale-omuddugavu. In both communities, cluster B basically comprised 4 cultivars; (Obumyufu (A), Obumyufu (C), Khaki/MP and Carolina. These were small (0.5-0.9 cm) seeded cultivars with slightly curved pod shapes. The cultivars in cluster A comprised of the Andean genepool; while those in cluster B represented the Mesoamerican gene pool.

Cultivar diversity. Both communities were managing an appreciable amount of diversity with equal cultivar richness of 21 cultivars and evenness of 0.81and 0.82 in rural and peri-urban communities, respectively. There was no significant difference (P>0.05) between the amount of the common bean diversity in the peri-urban and the rural communities. This can be seen from the very slight differences between the diversity estimates of the communities in Table 2.

A total of twenty four farmer-named common bean cultivars were found in the whole study. On average, farmers grew three cultivars as the mean on-farm richness was 3.55 and 3.63 in rural and peri-urban communities, respectively. The range in the number of cultivar was 2-7 and 2-8 in the rural and peri-urban communities, respectively.

There were no significant differences (P> 0.05) in the number of cultivars maintained by the farmers in the rural and the peri-urban communities. Cultivar composition of the communities was quite similar, with only 14.3% of the total cultivar richness being localised. The localised cultivars were: Nkoolankubalire, Obweru (B) and Congo found in only the peri-urban communities; while Yellow-omuwanvu,

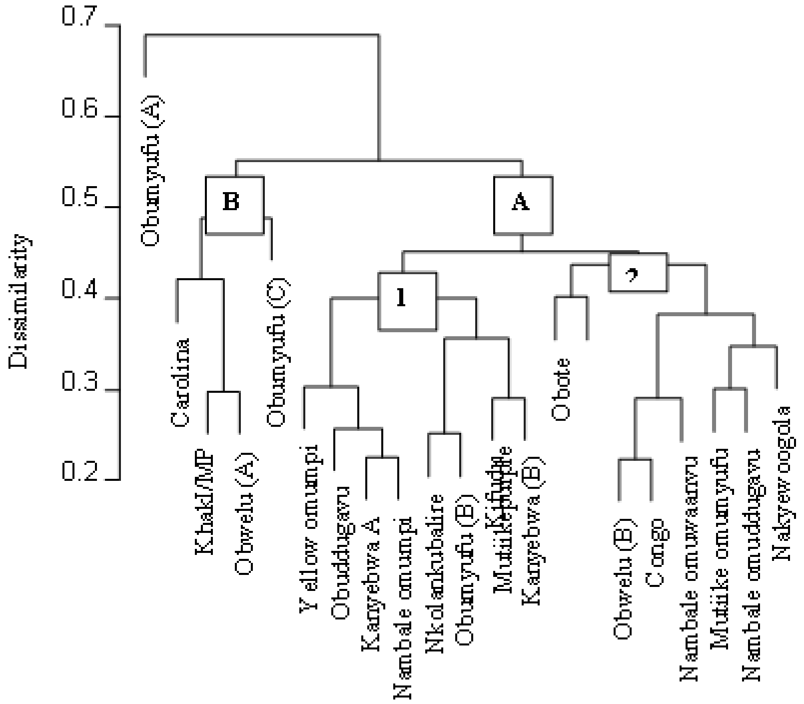

Figure 1b. Dendrogram pruned to show major clusters of UPGMA of Gowers' coefficient based on 18 characters and 105 individuals of common bean cultivars in the peri-urban communities of Mityana, Uganda (Mantel statistic r: 0.8512 significance: 0.001, based on 999 permutations).

TABLE 2. Diversity as estimated by Simpson's index of diversity (1-D) in the selected rural and peri-urban communities of Mityana district in Uganda based on number of cultivars and area allocated to each cultivar

Diversity measures	Rural communities	Peri-urban communities
Average household richness	3.55	3.63
Average household evenness	0.55	0.54
Community richness	21	21
Community Evenness	0.81	0.82
Divergence	0.32	0.35

Namunye (L) and Namunye (M) were localised in the rural communities**.** Both communities had substantial cultivar evenness at farm level (0.55 in rural and 0.54 in peri-urban) and, particularly at community level (0.81 in rural and 0.82 peri-urban). This indicated that farm diversity was not made up of a single dominant cultivar. Divergence, the possibility that two randomly chosen households within the same community were growing different sets of cultivars, was 0.32 and 0.35 in rural and peri-urban communities, respectively. This implied that at least 30% of all the farms in both communities managed different sets of cultivars.

Status of cultivars. Table 3 presents the extent and distribution of the cultivars by relative area of coverage and frequency of farmers growing the cultivar in both rural and peri-urban communities. Both communities had similar cultivars in all four categories. In both communities, the large area by many households basically comprised three cultivars: Nambaale-omuwanvu, Nambaale-omumpi and Yellow-

TABLE 3. Extent and distribution of *P.vulgaris* cultivars in selected peri-urban and rural communities of Mityana district in Uganda

Peri-urban communities			Rural communities		
Cultivar name	% of households	Coverage of the cultivar to total area allocated to common beans (%)	Cultivar name	% of households	Coverage of the cultivar to total area allocated to common bean (%)
Large by many households					
Nambaale-omumpi	68	39.80	Nambaale-omuwanvu	83	29.83
Nambaale-omuwanvu	50	20.70	Nambaale-omumpi	58	25.37
Yellow -omumpi	35	13.40	Yellow-omumpi	45	14.04
			Kanyeebwa (A)	25	10.62
Large by few households					
Obumyufu (C)	5	1.28	Obumyufu (B)	2	1.93
Obumyufu (B)	3	1.54	Kanyeebwa (B)	7	1.37
Obumyufu (A)	10	3.72	Yellow-omuwanvu	3	0.1
Nkoolankubalire	10	1.78			
Small by many households					
Mutiike -purple	13	0.47	Obweru (A)	30	7.25
Nakyewogola	17	0.83	Mutikke-omumyufu	10	0.21
Carolina	33	1.79	Nakyewogola	10	0.41
Mutikke-omumyufu	17	1.01	Carolina	15	0.88
Khaki / MP	20	2.03	Khaki / MP	12	1.3
Kanyebwa A	30	5.6	Obuddugavu	12	1.87
Obweru (A)	20	3.2	Obumyufu (A)	18	3.97
Obuddugavu	13	1.27			
Small by few households					
Congo	2	0.01	Obote	2	0.01
Kanyeebwa (B)	2	0.08	Namunye (L)	2	0.01
Kifudu	7	0.36	Nambaale-omuddugavu	3	0.06
Obweru (B)	7	0.57	Namunye(M)	2	0.03
Obote	2	0.16	Obumyufu (C)	3	0.14
Nambaale-omuddugavu	3	0.43	Mutiikepurple	7	0.16
			Kifudu	8	0.46

% exceed 100 because one household/ farm could have more than one cultivar

omumpi; although Kanyeebwa (A) was exclusive for the rural communities as per this category.

About 66 percent of the cultivars in both communities were either grown on small area by many households or on small area by few households. Although both communities had an equal number (14) of cultivars in these categories, 10 cultivars were common to both communities and the four cultivars varied for each community. The ten shared cultivars included Mutiike –omumyufu, Obugugavu, Obweru (A), Carolina, Khaki/MP, Nakyewoogola, Nambale-omuddugavu, Kiffudu and Mutiike purple.

DISCUSSION

Morphological characters for naming cultivars. In this study, farmers in both communities used distinct phenotypic features to describe, identify and name their common bean cultivars (Table 1); although the efficiency of their system depended on whether the cultivar in question was common or rare. Farmers ably described and named the common cultivars like Nambaale-omuwanvu, Nambaale-omumpi and Kanyeebwa, across study sites compared with the rare cultivars like Mutikke, Masavu and Nkolankubalire. This probably implies that farmers' names do not adequately approximate common bean diversity as only names for a few common cultivars can be justifiably used as distinct units of diversity measurement at the expense of the names of the many rare cultivars. If not assessed adequately, use of non-standardised farmers' names can underestimate the amount of common bean diversity maintained in communities.

Most cultivar names clearly reflected the morphological traits used in describing the cultivar in question like mature seed colour and seed size i.e. Obwelu (small white), Obumyufu (small red), Obuddugavu (small black), Kifudu (tortoise like), Namunye (insect), Nambaale-omuwanvu (long Nambaale) and Nambaale-omumpi (short Nambaale). This coincides with Mar and Holly (2000) who noted that farmers' names for local common bean varieties correlate with some of the crop's agro-morphological traits, especially seed colour.

As noted by Rijal (2007) that farmers distinguish diversity using categorical descriptors applicable to individual varieties. Farmers in both communities used two levels of descriptors especially when the first name does not adequately distinguish it i.e. Nambaale-omuwanvu, Nambaale-omumpi and Nambaale-omuddugavu are adequately identified in reference to their seed size and secondary colour. In some cases, farmers distinguished diversity by names created after their political leader (Obote, Mp), location (Nambaale a farm in Mityana), and animals (Namunye). Understanding how individual traits, and the groups of traits are used to identify and name landraces is important, because the agronomic and morphological characterisation of crop varieties is of direct relevance to farmers as well as plant breeders in their use of germplasm (Jarvis *et al.,* 2000).

In assessing cultivar morphological distinctiveness with standardised farmers' names between communities, standardised farmer-named cultivars were morphologically unique units (Table 1). The degree of agreement between the groupings from the cluster analysis (Fig. 1a and 1b) and PCoA were based on characters like seed size and shape. This indicated that farmers' standardised names were based on distinct morphological variation among the cultivars. This basically means that only standardised farmers' names based on distinct morphological traits can be used as reliable management units of diversity.

Rijal (2007) also noted a high degree of correspondence between farmer–named varieties and agro-morphological measurements, and he affirmed that 'names' approximate diversity better especially when they are created based on distinct morphological characters. The major limitations in the farmers' nomenclatural system included; giving the same name to cultivars that were morphologically different i.e., Obwelu A, B and C, Kanyeebwa A and B, Obumyufu A, B, and C and also certain cultivars were given different names yet they were the same varieties, e.g. Khaki was sometimes called MP and Kanyeebwa B was at times called Masavu.

Amount and status of the cultivars. The farmers in both communities were managing a substantial amount of common bean diversity as portrayed by diversity estimates. An average household cultivar richness of 3.55 and 3.63 (in rural and peri-urban communities, respectively) (Table 2) implied that farmers were perpetuating diverse populations of *P. vulgaris*. There were no significant differencesin the amount of diversity maintained by the farmers in both communities. This finding is important as it expresses the active engagement of the peri-urban communities in growing and managing diverse populations of the common bean because traditionally, only rural communities were known for maintaining diverse crop populations. Alternatively, there is fear that some diversity has probably been lost from the rural communities, but since we had no baseline data to confirm this, there is need to compare these results with studies from other communities in the country. In addition, maintaining diverse populations could probably be a strategy by the farmers, in both communities, to manage production risks like total cultivar failure due to biotic and abiotic factors in the agro-ecosystem.

The relatively high measures of cultivar evenness, both on household and community level (Table 2) implied that farmers were managing a substantial amount of common bean diversity, especially at community. However, the results from cell analysis showed that both communities shared the few common cultivars, the many rare cultivars; and differences were observed in the category of large, by few households where communities shared only one cultivar(Table 3). This probably implies that, to a larger extent, the farmers valued cultivars in the same way and this has two critical effects of either threatening or increasing the amount of diversity among the farmers maintaining the many rare cultivars grown on small area by many farmers or small area by few farmers.

The first issue of genetic erosion could be mirrored in the same perspective as Qualset *et al.'s* (1997) suggestion that small land holding isolate landrace populations from one another and, thus, reduce the generation of new genetic materials by natural recombination. Jarvis *et al.* (2000) also noted that small populations of farmer varieties are more susceptible to random events like drought, floods and war that have the potential to cause loss of diversity at different scales, from household to regional levels. Furthermore, if a cultivar is being maintained by very few famers on small areas, in case of the above mentioned stochastic events, the genetically effective size of these populations is more likely to be affected. This, however, brings on board other challenges like the need to assess the lower limits in terms of the number of farmers growing a particular cultivar and size of land it occupies for us to deduce that such a cultivar is getting threatened.

Although a couple of studies by e.g., Brown and Brubaker (2002) and Jarvis *et al.* (2008) have justified the use of area planted to a specific crop (in this case cultivar) as an indicator of genetic diversity, there is a gap in deducing the lowest area occupied by a cultivar population that can ensure its continued ability to adapt and evolve in a farming system. The second issue on the potential of increasing the amount of diversity is based on Louette *et al.'s* (1997) observation that when two populations are isolated, they will genetically diversify to a greater extent and, hence, result into inter-population diversity. The fact that many cultivars were grown on a small area but by many farmers, probably indicated a management strategy by the farmers in these communities to maintain diversity as an insurance to meet future environmental changes or social and economic needs as suggested by Jarvis *et al.*(2008). This was also supported by Rijal (2007) that farmers may maintain some cultivars in small proportions for specific reasons, thus, they will continue to exist in the system.

CONCLUSION

In conclusion, this study has provided the first ever baseline information on the number, percentage area coverage and the efficiency of using farmers' names in estimating common bean cultivar diversity in Uganda. Although a few challenges still exist, this information can be used to monitor changes in the various diversity measures like cultivar richness, evenness and in the distribution of the various cultivars within and between communities. As stressed by Brown and Hodgkin (2007), this information becomes more useful with supporting research on a couple of issues, i.e., link between environmental divergence and genetic diversity. Being in the climate change sensitive era, there is need to integrate this information with molecular studies of genetic diversity, especially the functional genomics to fully understand the adaptive traits with in this diversity and its implication to on-farm conservation and sustainable utilisation of the diversity for improved livelihoods. We need to compare trends over time and assess differences in vulnerability, usage patterns, conservation strategy and participatory plant breeding options for each class of cultivars.

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