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Scaling Niche Specific Common Beans (*Phaseolus vulgaris* L.) Varieties Based on Participatory Varietal Selection in Western Kenya

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ABSTRACT

In view of the wide gap between demand and supply of certified beans seed, limited varietal profile and seed scarcity in Kenya, the present study was undertaken in which six beans varieties procured across diverse Kenyan agro ecological situations were evaluated in participatory mode. The study was under taken in agro climatic conditions of Bungoma and Siaya counties of Western Kenya to find out basket of choice of farmer preferred varieties of common beans (Phaseolus vulgaris L.) through participatory varietal selection. 39 PVSs in Bungoma and 13 in Siaya were laid out at farmers' fields representing varied agro climatic situations. The preference analysis was based on four important characteristics viz., grain yield, maturity duration, diseases reaction and grain colour acceptance. The exercise provided farmers with a structured questionnaire to make their choice for subsequent analysis to enable identification of preferred bean varieties. The maximum preference rank and index for KAT-X-56, KK-16, GLP-2 and KK-194 varieties in Siaya suggested their preference by farmers. Siaya being a rainfall deficit area farmers can select KAT-X-56 and if its seed is not available than they may plan for other variety from any one out of these. In Bungoma the preference was for KK-16, KK-194 and Wairimu Dwarf varieties as evidenced from grain yield, diseases reaction and grain colour acceptance. If a Bungoma farmer prefer to grow an early maturing variety than KAT-X-56 is a suitable choice.

Key words: *Phaseolus vulgaris L., Participatory varietal selection, Western Kenya agro-ecological situation, Preference ranking, Farmer preferred varieties*

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is the most important legume crop in western Kenya, second only to maize as a food crop. The farming system is characteristically subsistence with a mixture of crops, livestock and trees. Low yields and small farm sizes mean that farmers in this region are not self-sufficient in food. Bungoma and Siaya counties of Western Kenya are characterized by diverse and heterogeneous environments and farming systems. Many development initiatives that target small holder beans farmers have not benefitted from improved production technologies grapple with scaling up and out agricultural innovations.

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One way of increasing the adoption of new varieties is to help farmers test for themselves a wide range of novel cultivars in their own fields. This process is termed Participatory Varietal Selection (PVS). In PVS, the cultivars should be selected carefully to match the traits that farmers require. To do this we ask farmers what qualities are required in the varieties that are important to them. They may, for example, specify that any new variety of beans must be early maturing; high yielding; less damaged by diseases and acceptable grain colour. Participatory varietal selection specifically refers to testing of released varieties, inbred and land races by farmers at their fields under their management. PVS approaches can be used to identify the best suited variety for a given location in a reduced time period at lesser cost. It allows the farmers to evaluate varieties for important traits and to make tradeoff between traits and tests varieties across more of the physical niches in which the crop is grown because the trials are replicated across more locations[6]. Farmers are increasingly and actively participating in evaluation process as development workers become more aware of the philosophy of "farmer first and its effectiveness[6]".One of the great strengths of PVS is that it is both an extension and a research method. A successful participatory varietal selection programme has four phases: (a participatory evaluation to identify farmers' needs in a cultivar; (b) a search for suitable varieties to test with farmers; (c) evaluation on their acceptability in farmers' fields and (d) wider dissemination of the farmer preferred cultivars. In the process of identifying a farmer preferred variety, farmer participation is seen as key to increase the probability of adoption of new varieties due to their evaluation in target environment. Keeping in view the wide gap between the demand and supply of certified beans seed and limited varietal profile and seed scarcity in Kenya, the present study was undertaken to evaluate six beans varieties procured across diverse agro ecological situations from Kenya in participatory mode. We have used already-released cultivars, not only from the target region but from other regions of the country. In Kenya, there are many varieties in other crops that have been released and widely grown only in a single state, yet have the potential to be useful in others. Using already-released cultivars saves time because sufficient seed is usually readily available. Farmer participatory varietal selection is used to address the problem of limited varietal choices available to cultivators. The resources available to farmers can be a very important factor in their adoption of varieties. Resource-poor farmers may have restricted access to new varieties and may be less willing to invest in, or risk, growing new varieties Yadavendra and Witcombe[6].

MATERIALS AND METHODS

In the present investigation thirty nine beans PVS trials were laid in Bungoma (26) and Siaya (13) counties of Western Kenya. Six beans varieties viz., KK-16, Wairimu Dwarf, KK-194, GLP-2, KAT-X-56 and the farmers' local in the trials were replicated across villages and across farmers within each village. Varieties KK-16, KK-8 from KALRO, Kakamega, Wairimu Dwarf, GLP-92 from Simlaw Seed Company, KAT-X-56 from KALRO, Katumani and individual farmer's own seed were used in the trials. Each trial was a single replicate as it had only one plot of each variety. They not only served as demonstration plots or focal points for discussions, but provided quantitative, analyzable data on yield, maturity days, disease reaction and grain colour acceptance. PVS assumes that varieties exists that are better than those currently grown, but farmers have not had the opportunity to test them.

These varieties were chosen on their performance potential and certainty of seed availability. Locations of the trials were identified to represent the typical diverse agro-ecological situations of the respective counties. Similarly, farmers who showed the interest in conducting the participatory varietal selection trial were selected across locations. For each location five kilograms seed of each five varieties mentioned above and own seed of respective farmers for planting before the onset of rainy season. Trials were laid out by farmers in their own fields. This approach has been employed to evaluate, identify and disseminate different varieties on farmer's field as per farmer's tastes regarding various traits and their perception and aspirations about varietal specifications.

On the basis of the feedback from the farming community, characters which determine the preference for a variety were considered viz., grain yield, maturity duration, diseases reaction and seed colour to collate the observations. In PVS trials, actual yield and days to maturity observations were recorded whereas preference ranking for diseases reaction and seed colour were considered by the farmers who conducted them. Farmers who participated in field days at the PVS sites were requested to provide their perceptions on the relevant four characters in the structured questionnaire given to them during the visit. Constant support was given to the PVS farmers and interactions during field days with the participating farmers were monitored by the field staff to minimize the error while recording the observations by the farmers. The mean preference score was worked out separately for all the four characters for 26 PVSs and three field days for Bungoma and 13 PVSs and one field day for Siaya to arrive at cumulative average preference of varieties on the basis of traits specified by them. The preference score index was calculated as described by De-Boef and Thijssen[2], Ceccarelli[1] and Shaikh *et.al.*[4] as under:

Preference Index =	Number of farmers gave first preference – Number farmers did not give first preference Total number of farmers participated in scoring

Average preference rankings as well as preference index were used to compare varieties for their superiority for all four traits by the farmers. Early maturity has been considered better over late maturity. Individual participants rank the varieties for each character separately More number of farmers preferred a variety is given the first rank and accordingly. It allows the understanding of choices between a set of varieties with identification of characteristics that distinguish them in addition to identification of criteria used by farmers to distinguish varieties. Results for each county are presented in the results part of this paper. In order to arrive at a conclusion the most farmers preferred variety (ies) for respective county has been identified.

EXPERIMENTAL RESULTS

Six genotypes of common beans (*Phseolus vulgaris* L.) were evaluated to identify suitable for niche areas of Bungoma and Siaya. These genotypes were evaluated in different agro-ecologies in a single replicate at 13 locations in Siaya and 26 locations in Bungoma. County wise details of results obtained are given separately in Table 1 and 2 respectively.

Table 1: Character wise results from participatory varietal selection and field days in Siaya county of Western Kenya

Variety	Actual observations on trait by PVS farmers (t/ha)	Preference ranking PVS farmers (n= 13)	Preference index PVS farmers (n=13)	Preference ranking field day farmers (n=105)	Preference index field day farmers (n=105)
Grain yield					
KK-16	1.04	2	-0.23	1	-0.01
Wairimu Dwarf	0.95	3	-0.54	5	-0.05
KK-194	0.70	1	0.08	4	-0.04
Local	0.85	3	-0.54	6	-0.06
GLP-92	1.08	1	-0.08	3	-0.03
KAT-X-56	1.29	1	0.08	2	-0.02
Days to maturity					
KK-16	74.69	2	-0.23	2	0.77
Wairimu Dwarf	71.08	3	-0.54	1	0.43
KK-194	75.54	1	0.08	3	0.30
Local	75.23	3	-0.54	4	0.24
GLP-92	72.85	1	0.08	3	0.55
KAT-X-56	70.85	1	0.08	1	0.75
Disease reaction					
KK-16	1.77	1	0.06	2	-0.15
Wairimu Dwarf	1.62	2	-0.03	3	-0.23
KK-194	1.85	2	0.02	3	-0.23
Local	2.31	4	-0.17	5	-0.40
GLP-92	2.08	3	-0.07	4	-0.31
KAT-X-56	1.54	2	-0.04	1	-0.08
Grain colour acceptance					
KK-16	1.08	1	1	1	1
Wairimu Dwarf	1.62	3	0.23	2	0.96
KK-194	1.00	2	0.54	4	0.64
Local	1.00	4	-0.08	6	0.31
GLP-92	1.77	3	0.23	5	0.37
KAT-X-56	1.46	1	1	3	0.92

PVS=Participatory Varietal Selection, FD=Field Day, n= Number of farmers participated in the field day.

Siaya

Grain yield

In PVSs the actual grain yield was recorded by the farmers along with the days to maturity. On the basis of the observations (Table 1) it was evident that in Siaya county beans variety KAT-X-56 was the highest yielding followed by GLP-2, KK-194, KK-16 and Wairimu Dwarf. It was interesting to observe that the farmers own local was found to be the poorest yielding. While working on the observation of preference index based on farmers who conducted the PVSs, again it was KAT-X-56 and KK-194 which were superior over others in Siaya. The preference index was lowest for Wairimu Dwarf and Local. When the data for average preference ranking based on farmers' perceptions during field days it was interesting to know that they also perceived the KK-16, KAT-X-56 and GLP-2 varieties preferred for Siaya County. Similar trend was observed for preference index where in addition to these three, KK-194 also came in their category.

Days to maturity

Number of days taken by a variety to mature for harvest is considered to be the days taken

for maturity. The farmers who conducted the trials recorded the total number of days when the variety was ready for harvest. Whereas, early maturity was the preference of majority farmers who participated in field days. The preference ranking as well as index for maturity duration observed by PVS farmers was positive for KAT-X-56, GLP-2 and KK-194 but was low for other varieties. Observations from the field day perceptions it was evident that the varieties which matured early had a better ranking as shown for KAT-X-56, Wairimu Dwarf and KK-16 further supported by preference indices 75, 55 and 77 respectively.

Disease reaction

Many diseases are affecting beans yield in Kenya and it is difficult for the farmers to identify the diseases hence over all perception on diseases damage is based on visual observations by the farmers. Results on diseases reaction are based on the perception of farmers who conducted the PVS trials and farmers who participated in the field day at Siaya. The preference index was also worked out from these perceptions for field day. The disease score by PVS farmers indicated that all the five varieties were less damaged by diseases compared to the local one. This was clearly visible in the disease score for the test varieties. When compared the ranking by field day farmers, the results showed the similar pattern and more so the preference index. Likewise in field day observations by participating farmers' preference ranking showed the superiority of KAT-X-56 and KK-16 over others further supported by the preference index for these varieties.

Grain colour acceptance

Grain appearance is an important criterion which determines the acceptability of the variety by the consumer. Grain colour of KK-16, KK-194 and KAT-X-56 was ranked as more preferable over other varieties as evidenced from the preference score by PVS farmers. The ranking along with preference index for grain colour acceptance given by PVS farmers was also in favour of these varieties. The preference ranking based on perception of the farmers participated in field day revealed the greater preference for KK-16 and Wairimu Dwarf over other varieties. The situation was similar when the preference indices were analysed for these varieties.

Bungoma

Grain Yield

In Bungoma County, KK-16 in PVS out yielded all other varieties followed by KAT-X-56, KK-194 and Wairimu Dwarf. Findings (Table 2) from the PVSs actual preference rankings also revealed that KK-16 followed by three other were superior over other varieties. in Bungoma. The PVS preference index was more for KK-16, KAT-X-56 and KK-194 where as the value for Wairimu Dwarf was on lower side when compared to GLP-2. The local was found to be inferior as evidenced by lowest yield potential, preference rank and preference index. Reviewing the results from field days, it was observed that in first field day KAT-X-56 was ranked fourth after KK-16, KK-194 and Wairimu Dwarf whereas in second and third field days KK-16, KK-194 and KAT-X-56 were in first three ranks. When the average of three field days was worked out, these three varieties were superior in preference rank as well as index. In all the field days KK-16 stood first in rank as well as index.

Days to maturity

Farmers who conducted the PVS trials found the KAT-X56 as early maturing followed by Wairimu Dwarf and KK-16. Local variety was the least preferred for this character as compared to other varieties due to its late maturity. The preference ranking was in favour of KAT-X-56, KK-16,Wairimu Dwarf and KK-194. While analyzing the preference ranking of individual field days, which was more in favour of KAT-X-56 and KK-16

followed by KK-194 whereas preference index was high for KAT-X-56 and KK-16 followed by Wairimu Dwarf. The entire information indicated that for maturity duration of all the three varieties viz., KAT-X-56, KK-16 and Wairimu Dwarf was suitable for Bungoma County. On the basis of field days analysis average preference ranking for maturity duration indicated suitability for KAT-X-56, KK-16 and Wairimu Dwarf. Average preference index was maximum for KAT-X-56, KK-16 and Wairimu Dwarf.

Table 2. Charcterwise results of participatory varietal selection and field days in Bungoma county of Western Kenya

Variety	Actual observations by PVS farmers (t/ha)	Preference ranking PVS farmers (n= 26)	Preference index PVS farmers (n=26)	Preference ranking field day -I farmers (n=105)	Preference index field day -I farmers (n=105)	Preference ranking field day-II farmers (n=46)	Preference index field day-II farmers (n=46)	Preference ranking field day-III farmers (n=75)	Preference index field day-III farmers (n=75)	Average preference ranking of field days	Average preference index of field days
Grain yield											
KK-16	1.23	1	0.46	1	0.98	1	0.97	1	0.00	1	0.65
Wairimu Dwarf	1.03	4	0.15	2	0.87	5	0.61	4	-0.04	4	0.48
KK-194	1.06	3	0.31	3	0.85	3	0.81	2	-0.02	3	0.55
Local	0.96	6	0.08	6	0.54	6	0.49	6	-0.07	6	0.32
GLP-92	0.98	5	0.23	5	0.56	4	0.63	5	-0.06	5	0.38
KAT-X-56	1.07	2	0.38	4	0.68	2	0.84	3	-0.03	3	0.50
Days to maturity											
KK-16	72.85	3	-0.31	3	0.50	2	0.69	1	0.87	2	0.69
Wairimu Dwarf	70.50	2	-0.23	3	0.83	5	0.87	3	0.60	4	0.77
KK-194	75.42	4	-0.15	5	0.60	1	0.73	4	0.52	3	0.62
Local	82.88	5	-0.38	6	0.54	4	0.84	5	0.41	5	0.60
GLP-92	72.65	3	-0.19	4	0.92	3	0.92	3	0.60	3	0.81
KAT-X-56	69.85	1	-0.15	1	1.00	1	0.87	2	0.84	1	0.90
Disease reaction											
KK-16	1.69	4	-0.15	2	0.12	5	-0.44	2	-0.17	3	-0.17
Wairimu Dwarf	1.81	3	-0.15	3	-0.18	2	-0.65	4	-0.23	3	-0.35
KK-194	2.35	1	-0.46	1	-0.31	1	-0.95	1	0.44	1	-0.06
Local	1.12	6	-0.38	4	-0.39	6	-0.44	6	-0.44	5	-0.42
GLP-92	1.72	2	-0.31	5	-0.33	4	-0.52	5	-0.28	5	-0.38
KAT-X-56	1.35	5	0.04	2	0.22	3	-0.63	3	-0.09	3	-0.27
Grain colour acceptance											
KK-16	1.00	1	0.85	1	1.00	3	0.12	1	1.00	2	0.71
Wairimu Dwarf	1.08	1	0.85	2	0.83	2	0.01	3	0.87	2	0.57
KK-194	1.23	2	0.54	4	0.43	1	0.07	3	0.87	3	0.45
Local	1.42	5	0.15	6	0.14	4	-0.28	5	0.28	5	0.05
GLP-92	1.31	4	0.38	5	0.30	3	-0.12	4	0.23	4	0.13
KAT-X-56	1.12	2	0.77	3	0.70	1	0.07	2	0.89	2	0.55

PVS=Participatory Varietal Selection, FD=Field Day, n= Number of farmers participated in the field day.

Diseases reaction

Farmers who conducted the PVS trials in Bungoma County preference was for varieties which showed less damage by diseases. From the results it was clear that in Bungoma varieties KK-194, KK-16 and Wairimu Dwarf had the highest ranking as 1, 2 1n3 respectively. The preference index for disease reaction by PVS farmers was again in favour of these three varieties. The perceptions of farmers in field days gave the preference for KK-194, KK-16, Wairimu Dwarf along with KAT-X-56 also. In average preference rankings in descending order these were KK-194, KK-16 , KAT-X-56 and Wairimu Dwarf. Since KAT-X-56 matured early hence during field days also this variety gained the favour of farmers witnessing the field days in respect of ranking as well as preference index.

Grain colour acceptance

Grain colour appearance is an important criterion which determines the acceptability of the variety by the consumer. Accordingly PVS farmers and field days farmer were requested to indicate their preference for this trait. PVS farmers' average ranking was in favour of KK-16, Wairimu Dwarf, KK-194 and KAT-X-56. The preference for GLP-2 was the least. In

preference index by PVS farmers in Bungoma County was high for KK-194, KK-16 and Wairimu Dwarf. The farmers in field days expressed their order of preference for KK-16, KK-194, wairimu Dwarf and KAT-X-56. The order of preference index indicated by farmers attending field days was also in agreement with the rankings for these varieties.

DISCUSSION

A common bean (*Phaseolus vulgaris* L.) is the second most important crop after maize cultivated by the farmers in Western Kenya. The present study was undertaken in Siaya and Bugoma Counties of Western Kenya to find out the farmer preferred varieties of common beans for general cultivation and alleviating farm economy by them. Further, to provide a basket of varietal choice to farmers to select most suitable variety for cultivation as per their requirement. Six varieties of beans including the farmers own variety (local) were evaluated in participatory varietal selection system under varied agro-climatologically conditions. Five varieties were identified from a pool of varieties developed and released for different ecologies of Kenya to meet their requirements in these two counties.

Preference ranking from farmers who conducted the PVS trials and who participated in field days organized at different places in both counties was worked out. Four characters were considered while obtaining the preferential score from both the categories of farmers. These were the four characters which farmers considered important while selecting a variety. On the basis of the preference rankings and indices from both categories of farmers in Siaya County it has been found clearly that KAT-X-56 was the most preferred variety. Other preferred varieties were KK-16 and KK-194.This was mainly due to early maturity and yield potential of KAT-X-56 which attracted farmers to select it. Since Siaya is a rain deficit area as compared to Bungoma, early maturity variety is a better choice of farmers. In addition to its early maturity and yield, this also has the acceptable grain colour hence better consumer acceptability. The beans varietal choice for Siaya farmers in order of preference was KAT-X-56, KK-16, KK-194 and GLP-2. For high yield potential, KAT-X-56 and GLP-2, for early maturity KAT-X-56, Wairimu Dwarf and KK-16, to overcome diseases menace KK-194 and for better grain colour KK-16 were the most preferred for Siaya agro climatic conditions.

In the agro climatic conditions of Bungoma, preference ranking was slightly deviated from Siaya. The varieties KK-16, KAT-X-56 and KK-194 were preferred over others as evidenced by their higher yield potential as well as their preference ranking and indices by PVS farmers. While analyzing the preference rankings and indices for yield obtained from field days activities it was KK-16 which surpassed all other varieties. For days to maturity KAT-X-56 and Wairimu dwarf were preferred by PVS farmers and from the results of field days preference rankings and indices were in favour of KAT-X-56 and GLP-2 and Wairimu Dwarf. The variety KK-194 was ranked highest over others by PVS farmers as well as by farmers in field days. The grain colour of varieties KK-16, Wairimu Dwarf, KAT-X-56 and KK-194 was better accepted in order of preference by PVS farmers as well as by farmers witnessed the field days. It was amply clear that in Bungoma agro climatic conditions varieties KK-16, KK-194 and Wairimu Dwarf excelled over others except for maturity duration where the preference was for KAT-X-56. It was interesting to realize that the local variety was not superior in any character and no preference was given by the farmers. This was primarily due to the fact the seed was a mixture of many local types and of variable behavior for all the traits including uneven maturing plant types.This investigation provided farmers with a large selection to make their choice for subsequent analysis to enable identification of preferred bean varieties[7]. The maximum preference rank and index for KAT-X-56, KK-16, GLP-2 and KK-194 varieties in Siaya suggested their preference by farmers hence Siaya being a low rainfall area they can select

first KAT-X-56 and if the seed is not available than they may plan for other from any one out of these. In Bungoma the preference was for KK-16, KK-194 and Wairimu Dwarf varieties from yield, diseases reaction and grain colour acceptance. If a Bungoma farmer prefer to grow an early maturing variety than KAT-X-56 is a suitable choice.No one bean variety had all the attributes farmers preferred. Hence, to compensate, most farmers may grow more than one variety. The study also showed that when farmer participatory approaches were used to evaluate and disseminate the improved bean varieties, farmers may use more than one variety depending upon their requirement. Farmers use a complex set of criteria to select the bean varieties they grow so they should also be more closely involved in selecting a variety. Criteria used are maturity, yield, grain colour acceptance, as well as disease reaction there is a need to involve both men and women in PVS.

CONCLUSION AND WAY FORWARD

On the basis of the findings from the present investigation, it was found that for the low rainfall areas of Siaya, variety KAT-X-56 developed by KALRO, Katumani has been the best choice of the PVS as well as field day farmers than the other varieties. This is due to short maturity duration of this variety. For the Bungoma County varieties like KK-16, KK-194 and Wairimu Dwarf have found the favour from the farmers because of their high yield and tolerance to diseases as compared to other varieties. KAT-X-56 was also early in maturity in Bungoma conditions as indicated in the preference rankings and indices by farmers. For scaling up the use of farmer preferred varieties for an impetus in boosting the farm economy of Siaya and Bungoma farmers, making the seed available at the door step of the farmer at right time at an appropriate seed price is the foremost requirement. The TechnoServe India has initiated an all out effort to meet this challenge. However concerted efforts are needed by the developmental agencies to find out a suitable model to minimize the gap between the seed demand and supply of the farmer preferred varieties of beans.

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