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ASSESSING PREFERENCE OF RELEASED IMPROVED HARICOT BEANS (*PHASEOLUS VULGARIS L.*) BY FARMERS IN THE WESTERN HIGHLANDS OF CAMEROON

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ABSTRACT

The need to increase productivity of Haricot beans and improve on the livelihood of farmers led to the introduction of improved Haricot beans with shorter life cycle, high yielding and resistant to pest and diseases. Despite these positive benefits, effective adoption has been slow as farmers remain reluctant to adopt most of these varieties. The survey, thus, focus on evaluating the production, marketing and consumption of released improved Haricot beans by farmers in the Western highlands. It also examines the socio-demographic factors that influence its adoption. Primary data was collected using questionnaires and interview guides that captured information on socio-demographic factors as well as production, marketing and consumption. Results obtained showed that farmers' experience in the cultivation of improved Haricot beans significantly influence their decision to adopt them. Mex 142 was the most adopted, cultivated and most preferred in terms of yield. In terms of marketing, Mex 142 and Ecapan 021 were the most preferred while TY3396-12 was preferred for taste. Policy makers and plant breeders should therefore lay more emphasis on preferred traits that will enhance production, marketing and consumption as a way to enhance productivity and livelihood of farmers.

INTRODUCTION

Phaseolus vulgaris L. commonly known as Haricot beans is the most important grain legume for direct human consumption worldwide (Boughton *et al*., 2003). The crop contains high protein content: it is a good source of energy and provide folic acid, dietary fiber and complex carbohydrates. Haricot beans is high in lysine, which is relatively deficient in maize, cassava and rice, making it a good complement to these staples in the diet (Buruchara, 2007). Therefore, in improving on its production and marketing, there is a high potential for raising food security and incomes of the rural households as well as ensuring sustainable development. Cameroon is amongst the top ten producers of Haricot beans in Sub Saharan Africa (Abate *et al*., 2012).

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The total area, yield and production between the period of 2005-2007 grew at the rate of about 231,000 ha, 876 kg per hectare and 285 metric tons respectively, which is not able to meet the growing domestic demand (FAOSTAT, 2010). The crop is mostly grown in the Western Highlands agro-ecological zone as an important food crop and source of cash to smallholder farmers (Ngueguim *et al*., 2010). In terms of trade, Cameroon exported 1.79 million metric tons between 2005 and 2007 with a steady increase in price from 2000 to 2008 (FAOSTAT, 2011). There has been an increase in the demand for Haricot beans in Cameroon, most especially from buyers from neighbouring countries of Central African Republic, Equatorial Guinea, Gabon, Chad, Nigeria and the Republic of Congo (Siri *et al*., 2014). Besides the cross border demand, the crop is highly solicited by institutions that feed their members such as boarding schools, hospitals, prisons, orphanages and military camps (*ibid*, 2014). These are good opportunities for Haricot beans farmers to exploit the market

system and effectively participate in the supply chain within and across national borders. It is therefore logical to assume that growth and improvement in the Haricot beans sub-sector can substantially contribute to economic development at sub-Regional, national and family levels in Cameroon. Nevertheless, it is noticed that the rising demand for Haricot beans as observed in the specific markets is not commensurate to the quantity produced; it is still very low as compared to the available potentials in the sector for business (Chalwe, 2011). This is exacerbated by the looming threat of climate change, low soil fertilities, storage pest and diseases, low use of fertilizers due to high cost and weak extension services. Consequently, smallholder farmers suffer from inadequate supply of Haricot beans, nutritional deficiencies and low income which has a bearing on their overall livelihood. Thus, there is a serious need to increase Haricot beans productivity especially within the main producing areas. This will go a long way in solving the problems of food insecurity, malnutrition, poverty as well as improve on farmer revenue.To address the Haricot beans production constraints, researchers in the national agricultural systems in Sub-Saharan Africa and international organizations, notably the International Center for Tropical Agricultural (CIAT), under the Pan Africa Bean Research Alliance (PABRA) have been developing Haricot beans varieties with improved resistance to biotic and abiotic stresses. The most outstanding characteristic of these varieties are their high yield potential, resistance to important diseases, and tolerant nature to low soil fertility (Chirwa *et al.,* 2007). Because of these values, improved Haricot beans varieties produce more than three times the average yields of the indigenous or local varieties and this is perhaps a good way of meeting the demand for Haricot beans in Cameroon.Cameroon has been a member of the Alliance for 11 years and is one of the most active members in West and Central Africa sub Region. Within this period PABRA in collaboration with the Institute of Agricultural Research for Development (IRAD) have released 12 improved varieties to farmers (PABRA database, 2015).

Amongst these varieties 7 (Mex 142, Nitu, TY3396-12, Mac 33, Mac 55, Ecanpan 021 and KJ4/3) were released in 2012 while the other 5 (NUA-99, BGG, DOR-701, PNN, NUV-109-2) were released in 2015. Amongst the improved varieties, other earlier released varieties were GLP-190 and Meringue. These varieties are a combination of both bush and climbing types and were selected for different traits including high yield, high nutrition content, resistance to various pests and diseases, tolerance to soil fertility and acceptable consumption and market traits (PABRA Database, 2015). The improved beans varieties were made known to farmers through a combination of channels such as participatory varietal selection (PVS) activities, on-farm demonstration, agricultural shows/field days, posters, radio episodes and television talks, newspapers and sensitization tours to farming groups. Despite the positive benefits of these varieties, effective adoption has been slow. There is, therefore, a need to gather information not only to identify factors affecting adoption but also to evaluate data on production, marketing and consumption of these varieties. The objective of this survey is to assess farmers' preference in terms of production, marketing and consumption of released improved Haricot beans in the Western highlands. It also examine the socio-economic factors that influence its adoption, with a view to providing relevant information to guide farmers, researchers, extension workers and policy makers on this very important crop. Specifically, information gathered in this study will enable plant breeders to incorporate preferred traits in their breeding program.

MATERIALS AND METHODS

Description of the Study Area

Based on the fact that most of the dissemination efforts of improved Haricot beans varieties were concentrated in the Western Highlands agro-ecological zone, this zone was chosen for the study. It comprises the West and North West Regions with a total surface area of 31 million hectares (GP-DERUDEP, 2006). It is further subdivided into three ecological zones based on altitude; lowland (<800m a.s.l), mid altitude (800 – 1500m a.s.l) and highlands (> 1500m a.s.l). The soil varies, ranging from andosols, generally fertile and rich in organic matter on the high plateau (2000-2700m) to ferralitic soils, often deep and impoverished by intensive cultivation in the valleys (1400-1500m). The soil type is equally rich in organic matter and good for maize, Irish potatoes, Haricot beans, carrot, cabbage, onion, leaks, green pepper, green beans, yams, water melons and cassava. The dry season runs from mid-November to mid-March. Daily temperature varies from 10 to 28 ^{o}C. The population of the agro-ecological zone stands at about 3.6 million with an average of 90-300 inhabitants per km^2 (2005 Census). Over 70% of the population depends entirely on agriculture for livelihood (Fonjong, 2007). The chief economic activities of these Regions are farming and the marketing of agricultural food crop with Haricot beans occupying a significant position.

Target Population, Sample size and Sampling Techniques

A total of six divisions were purposively selected (due to high intensity of improved Haricot beans dissemination) from the two Regions: three divisions (Babessi, Kumbo and Ndu) in the North West Region and three divisions (Noun, Mifi and Menoua) in the West Region. The choice of the different divisions permits the capturing of disparity in assessing varieties. After the divisions were selected, a two-stage simple random selection method was used. In the first stage, farmers who received improved Haricot beans seed varieties were randomly selected from each division. To select the farmers, in the second phase, a systematic random sampling procedure was followed. The researchers requested a group register from the group leaders or in some cases, the group secretaries. This register served as the sampling frame and each farmer in this list was numbered sequentially. The targeted farmers were selected at fixed interval from the list until 30 farmers were selected from each division. Therefore, 90 farmers were randomly selected from the North West Region and another 90 from the West Region to make a total of 180 farmers. The number of farmers selected in each of the survey divisions are presented in Table 1.

Data Type, Sources and Data Collection Procedure

Primary and secondary data were collected to answer the research questions and achieve the objectives of this survey. Additional information having direct or indirect bearing on the

study were gathered from sample farmers using interview schedule and focus group discussions. Relevant data were also gathered by examining secondary sources such as published scientific works, books, internet, unpublished documentations and administrative reports. Primary data for this study was collected using a pre-tested structured questionnaire. The instrument contained both closed-ended and open-ended questions. Closed-ended questions provided a basis for quantifying the data obtained while open-ended ones provided useful information that was used in explaining observations in the study.

Table 1. Distribution of farmers by Study Area

AEZ	Region	Division	Sub-Division	No of farmers
	North West	Ngoketunjia	Babessi	30
		Bui	Kumbo	30
		Donga-Mantung	Ndu	30
Western Highlands	Total	3	3	90
	West	Mifi	Bandjoun	30
		Noun	Foumbot	30
		Menoua	Balessing	30
	Total	3	3	90
Grand Total	2	6	6	180

Source: field work, 2016

Table 2. Influence of socio-demographic indicators on the adoption of improved Haricot beans

Indicators	Spearman's rho	Highest quantity ever produced for improved Haricot beans
Age in years	R	0.117
	P-Value	0.119
	N	180
Household size	R	0.117
	P-Value	0.118
	N	179
Total farming experience	R	-0.083
	P-Value	0.268
	N	180
Number of years in Haricot beans cultivation	R	-0.180*
	P-Value	0.016
	N	180
Number of years in improved Haricot beans cultivation	R	0.230**
	P-Value	0.002
	N	180

Source: field work 2016

The instrument had three sections. Section one contained information on socio-demographic characteristics of the farmers including age, gender, educational level, experience and family size. Section two contained information on current status of Haricot beans adoption, production, marketing and consumption. The data were collected through face-to-face interview using pre-tested structured questionnaires. These were filled up by recruited and trained enumerators under the close supervision of the researchers. In all, 180 randomly selected sample farmers were covered under the survey.Qualitative information was also recorded from selected farmers in view to have the right output from the survey work. Collection of primary qualitative information was managed through focused group discussions and individual farmers. Finally, primary data were supplemented with secondary data in order to ensure adequacy and reliability of information gathered.

Data Analysis

Quantitative data were collected and checked for correctness, coded and improved, including recording variables in SI Units, e.g. kg for weight, ha for acreage, etc. before being entered into Epi data. After entry, the data were cross-checked for accuracy and any anomalies found were corrected. The data were analyzed using Statistical Package for Social Sciences (SPSS) by computing descriptive statistics; including frequencies, percentages, minimum and maximum values, and averages. Statistical method such as chi-square test and Spearman Rho correlation were also used to analyze the quantitative data. Qualitative data were analyzed through content analysis by coding responses given by various interviewees and assessing them for differences and similarities. The results were interpreted in comparison with the results obtained from farmers' questionnaire.

RESULTS AND DISCUSSION

Influence of Socio-Demographic Factors on adoption of improved Haricot beans

The socio-demographic characteristics of the respondents that were studied in this survey are gender, age, level of education, household size, and marital status, source of income and years of farming experience with improved Haricot beans cultivation. Male and female were equally represented in the sample with a proportion of 50% respectively. The average age of farmers was 52 years, the youngest was 23 years while the oldest had 82 years. Additionally, results showed that most of the respondents (about 80.6%) went up to secondary level of education while 15% had no formal education. Farmers had family sizes ranging from 1 to 22 members with average family size of 8. The study also revealed that more than 80.6%

were married while 19.4% were not married. Farmers in the study area had farming and trading as the main occupation and source of income respectively. Furthermore, result indicated that farmers had been cultivating improved Haricot beans for an average of 3 years with the median at 2 years, and the maximum at 11 years. One of the objective of this study was designed to identify socio-demographic characteristics that influence the adoption of improved Haricot beans. The analysis in Table 2 showed that farmers experience in the cultivation of improved varieties influenced the adoption of improved Haricot beans varieties. There was a significant positive correlation between years of farming experience and adoption of improved seeds (Spearman's Rho; R=0.230, P=0.002). This implies that the likelihood of adoption by farmers increases for every additional increase in year of farming experience of improved Haricot beans. This result is consistence with past empirical studies carried out by Ogunyemi (2014) who found the years of farming experience as a significant factor in adoption model.

Varieties Grown and their Evaluation by farmers

Varieties grown

Both farmers and researchers evaluated the varieties cultivated in the two Regions of the Western Highlands agro-ecological zone. With the help of seed samples of different improved varieties, farmers were able to identify and rank the varieties grown. Figure 1 describes the varieties grown based on farmers' preference. Data analysis revealed that Mex 142 was the most adopted and cultivated variety followed by NUV-109-2 and Mac 55. Since sales from Haricot beans is the main source of income for majority of farmers across the study area, farmers are attracted to varieties that are high yielding and more demanding. Farmers explained that the type of improved variety planted influences the quantities of Haricot beans produced. During focus group discussions, a male farmer in Foumbot reported that growing the climbing types is another way to maximize yields, usually by supporting it with stakes or grown in association with other crops on which they climb. This confirms findings of this survey where farmers are attracted to improved climbing types like Mex 142 and NUV-109-2 that produces four times more than the local white and meringue varieties. This affirms findings of Willianas et al. (2005) that climbing varieties yield much better than dwarf under any conditions and are more suitable for intensive market farms.

Further analysis revealed that farmers in both Regions cultivate different varieties. Mac 55 was the most adopted and cultivated variety in the North West followed by Mac 33, Mex 142 and Ecapan 021. On the other hand, in the West Region the most adopted was Mex 142 followed by NUV-109-2, GLP-190 and TY3396-12 (Figure 2). The findings also revealed that farmers in the West cultivate more improved varieties as compared to those in the North West Region. From observation, many more varieties are grown in the West Region due to the availability of improved Haricot beans varieties in IRAD Foumbot.Another explanation is related to high exposure of these farmers from the West Region through activities such as agricultural shows/field days, on-farm demonstrations and sensitization seminars on these varieties than those from the North West Region. The absence of these activities in the North West Region slows down the rate of dissemination and adoption of these varieties among Haricot beans farmers.

Quantities produced

In terms of quantities produced, farmers across the survey area averagely produced 459kg of improved Haricot beans varieties as compared to an average of 391kg for the local varieties. Finding also indicate a significant difference in the quantities of improved Haricot beans produced (Mann Whitney U test: 3361.500; P=0.048). Farmers in the West Region averagely produced more quantities (561kg) compared to the quantities (357kg) produced by farmers in the North West Region (Table 3). Farmers in the West Region recounted during focus group discussion that those who practiced the mono-cropping system especially during the second season produced higher quantities. Although the second cropping season has been established to be the best for Haricot beans production in the West, this is not the case in most parts of the North West Region like Kumbo and Ndu with higher altitude. This rather contradictory result may be due to rapid decline in soil moisture immediately after rains have ceased leading to water stress, thus affecting production. This limits second season cultivation in Kumbo and Ndu unlike farmers in Babessi and the West Region who rely on this season to maximize yields.

Table 3. Comparing the production of Haricot beans by Region

Region		Highest quantity ever produced for improved Haricot beans in (kg)	Wilcoxon Signed Ranks Test
North West	N	90	Z=-2.076
	Mean	357	P=0.038
	Median	238	
	Minimum	51	
	Maximum	1666	
West	N	90	Z=-5.752
	Mean	561	P=0.000
	Median	391	
	Minimum	34	
	Maximum	4403	
Mann-Whitney U		U=3361.500 P=0.048	

Source: field work 2016

Types of Haricot beans produced

Although improved varieties have been reported to have a shorter life cycle, high yielding, resistant to drought and pest and diseases (Chirwa et al. 2007), farmers within the Western Highlands continue to cultivate both local and improved varieties. While 89.3% of farmers cultivated both local and improved varieties only 10.7% cultivate improved varieties. A majority of farmers (78.6%) testified that this is due to the availability and less expensive nature of the local varieties especially during planting season and high demand by local population after harvest. Farmers in the West reported that prices for local variety cost approximately 14 USD for 17kg while the cost of improved varieties is about 30 USD for the same quantity of seeds gotten from the market and research institutions (IRAD), respectively.However, those who were solely involved in the cultivation of improved varieties confirmed that they were motivated because of higher yields

especially for Mex 142 and good taste for TY3396-12. This confirms finding of a male farmer in Foumbot who harvested 476kg after planting just 17kg of Mex 142 as against 119kg harvested from 17kg of local white variety as recounted from another male farmer in Babessi (Focus group discussion). Therefore, the promotion of improved varieties would provide a sustainable solution to increase Haricot beans production and marketable surplus. Results in the two Regions showed significant variations in the type of Haricot beans produced (Cramer's V: V= 0.273; P=0.001) as shown on Figure 3. Farmers in the West Region were significantly (P<0.05) involved in cultivation of only improved seeds varieties (19.4%) than those in the North West Region (2.6%).

Farmer Evaluation of Variety Traits

To gain more understanding on the adoption of these varieties, farmers were asked to evaluate the varieties based on yields, market and consumption. Analysis of the data on Figure 3 reveals that the most preferred varieties in terms of yields was Mex 142 as reported by 52.2% of the farmers, followed by TY3396-12 and Ecapan 021. This trend was the same across the two Regions though farmers in the West significantly preferred Mex 142 while TY3396-12 was the first choice for farmers in the North West (P<0.05). The difference in the choices of varieties grown is associated to the cropping systems practiced by farmers in the two Regions. Farmers in the North West Region intercropped Haricot beans with various crops especially maize which is not favourable for pure climbing types like Mex 142. This was not the case with farmers in the West Region who are specialized only in mono-cropping of Haricot beans during second season production.

The majority (50.0%) of farmers reported that Mex 142 was the most marketed variety followed by Ecapan 021 as shown on Figure 3. Further comparison by Region reveals significant differences between farmers and market preferences (P<0.05). Farmers in the North West reported that Mex 142 and Ecapan 021 were the most marketed varieties with a higher proportion of 57.8% and 40.0% respectively. This finding applies more to farmers in Babessi who farmed on a large scale and during the second season (September cultivation). On the other hand, this was not the case in the West Region as a lesser proportion of farmers sold these varieties with a proportion of 42.7% for Mex 142 and 13.5% for Ecapan 021. As recounted by farmers, these are varieties that best responded to traders' choices especially distant traders who buy in bulk to take to big cities like Douala and Yaounde.Unlike preferences for yields and market, majority (48.8%) of the farmers generally preferred TY3396-12 followed by PNN in terms of taste and most consumed variety as indicated on Figure 3. There was no statistical difference between varieties and taste preference in the two Regions though TY3396-12 was highly competing with PNN in the West Region. Based on information during focus group discussion, farmers across the study area were particularly interested in the taste of TY3396-12 because of its nice aroma compared to the other improved varieties.

Factors influencing farmers' preference of varieties

To gain greater insights of farmers' histories of varieties use, farmers were asked again to rate the factors that influence adoption choices per variety.

Each farmer rated the factors on a scale of 6 based on their perception and experiences on yields, market and taste. Farmers were told that ratings toward 6 indicate good trait while 3 and 4 was a middle position implying neither good nor bad. This rating was verified with the researchers and enumerators to validate the results.Based on the analysis on Figure 4, the factors that determined adoption choices the most were high yield and good taste as reported by 55.7% and 25.6% of the farmers, respectively. Further analysis revealed that good colour and easy storage had basically no impact. It was observed that storage was not considered amongst farmers' preference because majority (75.5%) do not have access to storage facilities and as such were oblige to sell immediately after harvest to avoid post-harvest losses.

Conclusions

The objective of this survey was to assess farmers' preference in terms of production, marketing and consumption of released improved Haricot beans in the Western highlands. In addition, the study has examine the socio-demographic factors that influence the adoption of improved Haricot beans in the study area. The following conclusions are drawn from the survey:

- It was confirmed that farmers' experience in the cultivation of improved Haricot beans varieties significantly influence adoption decision.
- As expressed by the farmers, Mex 142 was the most adopted and cultivated variety followed by NUV-109-2 and Mac 55.
- It was established that farmers in the West Region averagely adopt and produced more varieties and quantities of improved Haricot beans varieties than farmers in the North West Region.
- The result also showed that the most preferred improved variety in terms of yield was Mex 142 followed by TY3396-12 and Ecapan 021 while Mex 142 and Ecapan 021 were the most preferred in terms of marketing and TY3396-12 in terms of taste.
- Finally, high yields and good taste were the main factors that determine the adoption preference of improved varieties by farmers.

Recommendation

Based on the findings of this survey the following recommendations were suggested to researchers, breeders and other stakeholders:

- Farmers across the study area were specific in the adoption and production of improved varieties. As such the multiplication of high yielding Haricot beans varieties with the desired farmers' traits can increase production that will contribute to food security in the zone and Cameroon at large.
- Even though the studied areas are the main growing localities of Haricot beans in the zone, farmers' cultivate Haricot beans differently in the two production seasons. Therefore emphasis should be given to improved Haricot beans that are adaptable not only to the agro-ecological zones but to the different production seasons.

- Farmers across the study area complained of high cost of improved seeds especially during planting season. Thus, to ensure high adoption rate, improved varieties should be given out at subsidized prices to farmers.
- Emphasis should also be given towards creating farmers' awareness on different released improved varieties in the North West Region through activities like the agricultural shows/field days, on-farm demonstrations and sensitization meetings on these varieties.
- Lower quantities were produced the North West Region due to high intercropping activities with maize. Hence, Haricot beans varieties that are compatible with maize based cropping system need to be determined.

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