Nakazi *et al. Agric & Food Secur (2017) 6:22*
DOI 10.1186/s40066-017-0102-z

Agriculture & Food Security

RESEARCH Open Access

Is bean really a women's crop? Men and women's participation in bean production in Uganda

Florence Nakazi[1*], Jemimah Njuki[2], Michael Adrogu Ugen[1], Paul Aseete[1], Enid Katungi[3], Eliud Birachi[4], Ruth Kabanyoro[5], Isaac Joseph Mugagga[1] and Grace Nanyonjo[1]

Abstract

Background: Common bean one of the grain legumes that was traditionally considered a subsistence crop and therefore a woman's crop in Uganda was prioritized for commercialization. This has transformed the crop from being a subsistence crop (food security crop) to a commercial crop with more men engaged in its production. Little is known about the possibility of gender conflicts in production activities as the crop finds market.

Methods: The study uses gender-disaggregated survey data from 500 men and 625 women in central Uganda. Both bivariate and multivariate methods were used to access the notion of bean being a women's crop based on gender participation intensities (a pairwise *t* test and Tobit regression model).

Results: Seventy-three percent male-headed and 87% female-headed households had membership in farmers groups. Bean crop was majorly owned by women. Seventy-five percent of the studied bean plots were intercropped with other crops. On average, both men and women operated at one bean plot per season estimated. Winnowing (4.26), post-harvest handling and storage (4.25), sorting (4.22), planting (4.04) and weeding (4.00) were the five top most activities that rural women heavily participated in. The following are the top most five activities that men participated in: site selection (3.94), spraying against pests and diseases (3.81), bush clearing (3.77), fertilizer application (3.73) and harvesting beans (3.73). Bean consumption (1.3%), marketability (17.5%), distance to plot (8.1%), education (1.3%) and color (18.1%) had significant influence on women participation intensities. Household size (5.8%), farming as primary occupation (42.7%) and bean color (30.8%) had significant influence on men bean participation intensities.

Conclusions: The study revealed there was significantly no bean production activity that was purely done by only men or only done by women. Thus, bean cannot be classified as a women's crop based on participation intensities since men offered support in a number of activities. In order to close the gender gap in bean production, there is need to target both men and women with gendered interventions and address issues of traditional norms.

Keywords: Bean a women's crop, Production activities, Participation, Tobit model

Background

In Africa, women play a significant role in agricultural and food production though it is empirically impossible to verify the share produced by them [1]. Among the most important crops that men and women participate in are grain legumes, and specifically common beans (*Phaseolus vulgaris* L.). This is particularly important in grain legume production, where role balancing may be necessary and where grain legumes play a significant role in the diets of many households worldwide as important sources of proteins [2].

In Uganda, common bean one of the grain legumes that was traditionally considered a subsistence crop and therefore a woman's crop was prioritized for commercialization in response to the National Development Plan

*Correspondence: nakkarence@gmail.com
[1] Legumes Programme, National Crops Resources Research Institute (NaCRRI), P. O. Box 7084, Kampala, Uganda
Full list of author information is available at the end of the article

II (2015/2016–2019/2020) due to its increasing contribution to export earnings. With increased government efforts geared toward bean commercialization, the crop is transforming from being a subsistence crop (food security crop) to a commercial crop. This has been influenced by the growing demand for processing of beans into value-added products like flour, snacks and ready-to-eat beans and the increased foreign exchange earnings to the country. Bean exports from Uganda to neighboring countries of Burundi, Democratic Republic of Congo (DRC), Kenya, Rwanda and South Sudan for foreign exchange earnings have been observed [3, 4].

Due to the increasing demand for beans both locally and internationally, their production in Uganda has been growing significantly for the past decades to meet the market demand. The literature suggests that as many crops that were traditionally subsistence crops and therefore regarded women's crops (cassava in Malawi and Nigeria) tend to commercialization [5, 6], gender role conflicts emerge. Therefore, as we observe bean that was traditionally considered a women's crop now becoming increasingly grown by men for its cash income and profitability, little is known about possibility of conflict between men and women as commercialization takes root in bean production. This study sets out to investigate men and women participation levels in production activities as the bean crop finds market. This calls for policies that can create a win–win situation for men and women once the crop becomes more profitable and as more efforts are geared toward increasing amounts produced for the market. The rest of the paper is organized into four sections: "Gender dynamics in bean crop production" section reviews literature related to the study, "Methods" section outlines the study methods, while "Results and discussion" presents results and their discussion. The last section concludes the paper and highlights key policy implications for fostering bean production for the benefit of men and women.

Gender dynamics in bean crop production

Uganda was ranked the eighth in bean production in the world with its annual production being estimated at 464,105 metric tons [7]. Bean is the second most frequently cultivated crop after Maize in Uganda [8]. With 7.7% steady increase in bean production in Uganda between 2001 and 2010 [4], it has resulted into a tremendous shift from subsistence to being a commercial crop. Households in Uganda indeed do not only depend on beans for their food security needs but also sell them in order to meet other household financial needs, such as school fees and essential non-food items. In Uganda, it is estimated that women contribute 56% of crop production labor [9] and contribute up to 90% of total food production. This evidence gives a clear indication that Ugandan agriculture has a woman's face [10]. Marketing is openly dominated by men [2], given that we also show in the paper that this is where men want to come in, so women's involvement here would be minimal which would limit data. This is similar to decision making as well. Hence, it was more prudent to focus on bean production activities where a sizable involvement of women was more evident.

The term women's crops are a familiar feature in writing about smallholder agriculture in Africa. Although not always easy to define, different scholars have offered different meanings for the term. Njuki et al. [11] referred to women's crops as those where women provide a significantly a greater proportion of labor. Women's crops were defined by Doss [12] as those crops in which women have more levels of control over decision making in various steps in production. Traditional gender norms in agrarian communities view women's crops as those that are produced for home consumption; and men's crops as crops grown by men for sale. This was majorly attributed to the norm that women are majorly involved in the primary production of subsistence crops and men in the production of cash crops. Doss [12] attributes this gender division of crops to women responsibility of feeding the family and men responsibility of providing cash income.

Different studies have conceptualized women's crops based on different settings. In Malawi, beans are a considered a women's crop because: (a) about 90% of the labor is provided by women, (b) decision making concerning beans are carried out by women and (c) they are usually the most knowledgeable about the crop [11]. In southern Africa, groundnut is regarded as a 'women's crop' primarily because much of the labor is provided by women [13]. The transition of crops from subsistence to being market oriented is widely believed to result into diverse outcomes for women farmers, with some outcomes being positive and others negative.

On the negative side, commercialization of crops is believed to disempower women as gender roles tend to conflict. Men tend to assert that they are income providers so as to gain control of the income from food crops, while women tend to be suppliers of labor. Commercialization of irrigated rice in Gambia, for example, subverted women's rights to land, increased male control over their labor power and turned women farmers into hired workers [14, 15]. The case was not any different from that of French beans in Kenya [16], hybrid maize in Zambia [17] and banana in Kenya [18].

On the positive side, there are cases where commercialization is believed not to reduce women control over crops as case of groundnuts in Zambia's Eastern Province [5], cassava in Malawi and Nigeria [19] and onions in

Northern Ghana [20]. Given that we are not sure of what will happen to women's participation in bean-related activities in Uganda when the crop finds market, it calls for investigative efforts to understand men and women's participation in bean production to ably target interventions in the sub-sector and make informed policies that can make bean a profitable crop for women once the crop becomes more profitable.

The literature on participation and gender reveals great complexity around women's and men's participation in agricultural production [1, 12, 21]. One major concern is the gender division of labor where household members participate in different activities based on gender roles and responsibilities. These roles can be divided based on the type of crop and type of agricultural task [20]. Chayal et al. [22] highlighted weeding, winnowing, harvesting, drying of grains, storage and processing as majorly being women tasks. Okonya and Kroschel [23] highlighted cutting vines as being a female-dominated task in sweet potato production in Uganda. Differences in participation could also be attributed to access and control over resources such as labor and land, and other inputs such as credit, varieties, fertilizers and information [11, 12, 21, 24]. This study focuses on men and women participation in production because women's participation in Africa's agriculture is largely via providing labor [9]. Gender studies have explored gender relations based on wider social constructions of male- versus female-headed households without digging deep into the gender participation rates in agricultural production at the household level. Participation of men and women in agricultural production has been cited by Alene et al. [25], Nakazi and Sserunkuuma [26] and Bellemare and Barrett [27] to be influenced by a number of factors among which are distance to fields, farm size, human capital, membership to groups among others. However, it is not known whether these same factors dynamics apply to bean production as the crop tends toward commercialization and with more men getting into its production. The real concern about the determinants of men and women participation in bean production is important.

Common bean being one of the traditional subsistence crops which was initially for home consumption in Uganda, women have to carry out a number of activities during any given bean cropping season to have beans ready for the table. Despite the significant representation of women in the bean sub-sector, little or no empirical study in Uganda has ever focused on comparison of men and women participation in bean production to examine whether bean is a women's crop or not. This is important given the fact that men and women participate at varying levels in bean production and their participation could be attributed to various reasons including providing food and generating income. We believe that gender inequality in bean sub-sector exists not only in the access to valuable resources such as land, credit and agricultural inputs, technology, extension, training and among other services but also in participation in bean production activities. By understanding these differences and the gendered participation factors behind them, programmes and policies will be able to achieve greater equity and efficiency.

One way to increase commercialization of beans in Uganda has been the introduction of beans targeted at processing industry, where farmers plant and deliver produce to processors. In other incidences, farmers deliver to large-scale traders through advance arrangements. These kinds of interventions thus called for the need to carefully evaluate the effects of the interventions on the consequent participation of men and women in bean activities, and in particular what is happening among men and women relative to production participation intensities. It was therefore deemed necessary to analyze the various roles men and women play in bean production to identify obstacles to reducing gender biases in bean production and document their hindrances in poverty reduction and economic development programs. Also, if we could clearly classify beans as a woman's crop, we could use such knowledge to examine the variable effects of agricultural policies on bean production.

In this paper, we attempt to provide answers to whether bean is a women's crop or not in Uganda with specific emphasis on two key research questions: (a) What are the patterns of men and women participation in bean production? and (b) what determines the participation rate of men and women in bean production? The current study is part of a bigger research project aimed at understanding the barriers and opportunities for enhancing gender mainstreaming in the value-added bean value chain development. We aim to highlight gender specific differences that are often overlooked in bean production.

Methods

The study makes use of data that were collected from 659 farm households between June and August 2015 in ten districts of central Uganda: Mubende, Rakai, Masaka, Mityana, Kalungu, Bukomasimbi, Lwengo, Lyantode, Kiboga and Sembabule. These were purposively selected because they form the ten project intervention districts where NARO and its partners were already working under the CultiAF[1] "precooked bean" project. A multistage purposive sampling procedure was used to reach the target respondents. The first line of sampling was selection of intervention districts as primary sampling

[1] Cultivate Africa's Future (CultiAF) project funding by IDRC and ACIAR.

units. Using district bean production data provided by the district production officers, sub-counties were purposively selected as secondary sampling units based on their productivity potential and availability of farmers groups selected as intervention groups by the project. Group location information was then used to develop the list of villages for sampling by local administrative staff. To arrive at the targeted sample size, random sampling of farmers per village was done and 659 bean-growing households were selected for the survey. Of these, 542 and 117 were male- and female-headed households, respectively.

Data were collected from farm households using trained enumerators and pretested questionnaires. The study collected gender-disaggregated data on March–June 2015 bean production season activities, in which case the principal male/female decision maker was interviewed. These were the husband and wife in male-headed households. In female-headed households, the second decision maker was identified as an adult male in the household. In a few cases where either the household head or spouse was absent, an appointment was secured to interview the two principle decision makers. From this technique, a total of 500 and 626 men and women were interviewed respectively.

Data were collected on general household characteristics (demography, income, asset endowments and institutional characteristics). Data were also collected on the gender-disaggregated perceived levels of participation. Participation in this study was perceived in terms of how much labor is devoted by a farmer to bean-related production activities. Fourteen bean production activities were keenly studied: site selection, bush clearing, land opening, final land plowing, planting, weeding, spraying against pests and diseases, fertilizer application, harvesting, transporting bean from the garden, threshing, winnowing, sorting, and post-harvest and storage. The perceived levels of participation were collected using Likert-type scales to mask variation in participation rates which yes/no kind of responses could not. These took the form of: 'very much,' 'much,' 'neutral,' 'minimal' and 'no participation at all' which was assigned scores of 5, 4, 3, 2 and 1, respectively. This was guided by time allocated to a given activity and how frequently a given activity was performed by either men or women. The study, however, did not collect qualitative information to thoroughly exhaust the participation rates at the focus group level.

The paper uses both univariate and bivariate methods to examine whether bean can be classified as a women's crop based on gender participation levels in production. Two steps were critically followed to analyze gendered extent of participation. First, the frequencies of responses from each of the five-point continuum of each activity were tabulated and multiplied by concerned score. They were then added together to get the perceived weighted average score for each activity. In the second step, the weighted average scores were subjected to the difference of means test (pairwise *t* test) to determine whether there is a significant difference between men and women participation in each activity.

Tobit regression model was used to assess the factors that influence participation intensities of men and women in bean production during any given season. First, the individual activity-weighted average scores were aggregated to generate a weighted gender participation index (WGPI) for each farmer. WGPI would be 1 if a farmer did not participate at all in any bean-related activity and could be >1 for farmers who participated in related activities. The gender-disaggregated WGPI was defined for each farmer as follows:

$$\mathrm{WGPI}_g = \frac{\sum_{j=1}^{k} W_{jg} S_{jg}}{\sum_{j=1}^{k} W_{jg}} \tag{1}$$

where W is the weighting score, S is the perceived level of participation, the subscript j is a bean production activity, k is the number of bean production activities (14 in our case) and g refers to either men or women.

In the second step, the WGPI was applied in the Tobit regression model as our dependent variable to assess factors that influence participation of men and women in bean production during any given season. The dependent variable (WGPI) is censored with lower limit as one and upper limit as five. According to Greene [28], a generalized two-tailed Tobit model is specified as:

$$y_i^* = \alpha X_i + \varepsilon_i \tag{2}$$

where y_i^* is a latent variable (unobserved for values <1 and >5), α is a vector of coefficients to be estimated, ε_i is a vector of independently normally distributed error terms with zero mean and constant variance σ^2, X_i is the vector of explanatory variables and $i = 1, 2, \ldots, n$ (n is the number of explanatory variables). Denoting y_i (WGPI) as the observed dependent (censored) variable,

$$y_i = \begin{cases} 1 & \text{if} \quad y_i^* \leq 1 \\ y_i^* & \text{if} \quad 1 \angle y_i^* \angle 5 \\ 5 & \text{if} \quad y_i^* \geq 5 \end{cases} \tag{3}$$

The Tobit model was chosen over the other models because: (a) of all the available models, it is only the Tobit that takes into account both the probability and intensity of participation and (b) it avoids lumping all non-participating farmers as one or and all participating farmers five, thereby masking variation in the dependent variable. The explanatory variables used in the estimation of the model were:

Table 1 Socio-demographic characteristics of sampled households

Variable	Male headed ($N = 542$)	Female headed ($N = 117$)	Chi-square/t test
Marital status (%)			
Married	98.71	19.66	
Single	0.18	3.42	464.41***
Widowed	0.74	64.10	
Divorced/separated	0.37	12.82	
Level of formal education (%)			
Never	7.56	17.95	
Primary	60.70	62.39	18.72***
Lower secondary	19.37	16.24	
Upper secondary and above	12.36	3.42	
Membership in farmers groups (%)	73.43	87.18	3.17***
Primary occupation farming (%)	85.79	97.44	3.53***
Age (years)	48.10 (13.01)	53.81 (11.20)	4.413***

***, **, * Significant at 1, 5 and 10%, respectively; in parentheses are standard deviations

1. *Farmer-/household-specific variables* HH_size_above15 defined as the number of household members who are above 15 and <66 years in a household; dependency_ratio was computed by dividing the total number of dependants (number below 15 and number of members above 66 years) over the total household size; ln age natural log of age in years; No_times_beans_consumed is the number of times the household consumed beans in the last 7 days.
2. *Farm-specific variables* Bean_plots is the number of bean plots operated in a season; lnbean_acres is natural log of bean area in acres planted; intercropping is a dummy equal to 1 if farmers practice intercropping, 0 otherwise; lndist_plot_KM is natural log of distance from household to bean plots in kilometers;
3. *Capital endowments and institutional factors* membership is dummy equal to 1 if farmer has membership in farmers association, 0 otherwise; lnannual_crop_income natural log of annual crop income in Uganda shillings; farming a dummy equal to 1 if primary occupation is farming, 0 otherwise; dist_mkt_minutes is distance to nearest market in walking minutes; educ is the number of years of formal schooling; Asset_index computed from household, farm and livestock assets.
4. *Bean variety attributes* Yield is dummy equal to 1 if farmer considers yield in selection of which bean variety to grow; taste dummy equal to 1 if farmer considers taste in selection of which bean variety to grow; color dummy equal to 1 if farmer considers color in selection of which bean variety to grow; marketability dummy equal to 1 if farmer considers yield in selection of which bean variety to grow.

The implicit functional form estimated to test farmers' participation is specified as:

$$\begin{aligned}&\text{Weighted gender participation Index (WGPI)}\\&= f(\text{HH\_size\_above15dependency\_ratio ln}\\&\quad \text{ageNo\_times\_beans\_consumededucBean\_plots}\\&\quad \text{ln bean\_acres intercropping}\\&\quad \text{ln dist\_plot\_KMmembership}\\&\quad \text{ln annual\_crop\_income farming}\\&\quad \text{dist\_mkt\_minuteseducAsset\_index}\\&\quad \text{Yield color taste Marketability}) + e\end{aligned}$$

where the dependent variable is mixed in a sense that farmers who did not participate in any activity at all have a value of 1 for the dependent variable, while those who participate in bean-related activities have a continuous outcome defined by the proportion ($1 < p \leq 5$). The rest of the explanatory variables are as earlier defined.

Results and discussion

Descriptive statistics

To describe the sample, tests of difference of the means (for continuous variables, e.g., age, bean plots, distance, size of bean plots) and Chi-square (for discrete variables, e.g., marital status, education, membership, farming, intercropping, ownership of crop and bean plots and rating soil fertility) were used to determine the differences in both household socio-demographic and bean plot characteristics. Table 1 presents the socio-demographics characteristics of the sampled bean-growing households. The sample comprised of more married male household heads (99%) as compared to female heads which were widowed (64%). Results also indicated that female

Table 2 Characteristics of the bean plots

Variables	Male headed ($N = 542$)	Female headed ($N = 117$)	Chi-square/*t* test
Intercropping (%)	73.12	76.55	0.86
Who owns the bean crop (%)			
Men	32.27	4.59	97.66***
Women	35.11	86.24	
Both men and women	32.62	9.17	
Who owns the bean plots (%)			
Men	84.01	16.26	
Women	4.04	68.29	354.09***
Both men and women	11.95	15.45	
Mode of land acquisition for bean plots (%)			
Purchased	51.71	29.66	
Borrowed/rented in	20.60	19.31	37.51***
Inherited	26.60	51.03	
Government	1.09		
Rating of the soil fertility (%)			
Good	30.97	29.66	
Medium	59.62	55.17	4.35
Poor	9.41	15.17	
Average number of bean plots	1.22 (0.59)	0.84 (0.46)	2.85***
Size of bean plot (acres)	1.04 (0.90)	0.78 (0.55)	3.19***
Average distance to bean plot (km)	0.99 (0.95)	0.92 (0.86)	1.16

***, **, * Significant at 1, 5 and 10%, respectively

household heads were significantly older (54 years) as compared to their male counterparts (48 years). Regardless of the household headship, all household heads had attained some primary level of education (61 and 62% for male and female, respectively). The study finds significantly higher proportions of male-headed households (97%) being engaged in farming as their primary occupation.

The general characteristics of the bean plots were examined (Table 2). Regardless of the household head, results show that the bean crop is majorly owned by women. The association could be derived from several factors including it being mainly grown for food and its low input requirements. In this study, we conceptualized ownership of bean plots as a person who has rights to use and/or sell, and give away that particular piece of land on which beans had been grown. The study found 84% of male- and 68% of female-headed households' bean plots were owned by men and women, respectively. This corroborates with the findings of Lemlem et al. [29] that women own most of land through male relatives.

Though not significant, it is worth noting that over 70% of the bean plots followed the intercropping system. This could be attributed to the fact that farmers are risk averse and therefore try to spread risks if they are to lose from any of the crops. This is in line with the findings of Birachi [30] in Tanzania, Malawi and Zambia where beans were also majorly intercropped and rarely planted as a sole crop.

Econometric results

Do men and women participate equally in bean production?

We examined whether bean can be clearly identified as a women's crop by looking at men and women participation intensities in bean production activities. Table 3 shows the comparison of women and men weighted average scores of each of the selected 14 activities and indicates whether these scores are statistically different between them. Results reveal that rural women were heavily involved in winnowing which was rated most high with an average weighted score of 4.26, followed by post-harvest handling and storage (4.25), sorting (4.22), planting (4.04), weeding (4.00) among others. The top most five bean production activities in which men reported heavy participation included: site selection, spraying against pests and diseases, bush clearing, fertilizer application and harvesting beans with average weighted scores of 3.94, 3.81, 3.77, 3.73 and 3.73, respectively. Women thus have significant participation in bean production activities of planting, weeding, harvesting, transporting beans from the garden, threshing beans, winnowing, sorting and post-harvest handling and

Table 3 Extent of participation in bean production activities

Activity	Weighted average scores		Difference
	Women	Men	
Site selection	3.85	3.94	M*
Bush clearing	3.03	3.77	M***
Land opening	3.41	3.56	M**
Final land plowing	3.59	3.50	N/A
Planting	4.04	3.39	W***
Weeding	4.00	3.27	W***
Spray against pests and diseases	3.27	3.81	M***
Fertilizer application	3.29	3.73	M***
Harvest beans	3.49	3.73	M*
Transport beans from the garden	3.69	3.11	W***
Threshing	3.93	2.99	W***
Winnowing	4.26	2.87	W***
Sorting	4.22	3.06	W***
Post-harvest and storage	4.25	3.32	W***

W*** denotes weighted average score of women participation greater than weighted average score of men at 1% significance level; M*** denotes weighted average score of men participation greater than weighted average score of women at 1% significance level; M** denotes weighted average score of men participation greater than weighted average score of women at 5% significance level; M* denotes weighted average score of men participation greater than weighted average score of women at 10% significance level

storage of beans. Women great participation in planting and weeding activities indicates their significant concern for better and vigorous growth and development of beans at early growth stage. This corroborates with the findings of Chayal et al. [22] who found weeding as one of the major activities that women greatly participate in. Men's higher participation in site selection could indirectly reveal that they are the land owners who always have to give permission before women can plant beans.

The study also revealed that men offered support in a number of bean-related production activities more especially those that required more energy. This is evidently seen in spraying against pests and diseases, bush clearing, fertilizer application and harvesting. This finding is in agreement with the findings of [29, 31] who found men to be typically responsible for the heavier manual tasks such as land preparation. There were no significant differences in final land plowing which could indicate that the activity is majorly done either by hired labor or by both men and women as farmers try to catch up with seasons. In totality, the study findings conform to the findings of [24, 31, 32] who appraised women for their undivided participation in production of crops right from the land preparation till post-harvest activities but it does not mean that bean is a women's crop since no activity was purely done by only women. The study findings are also in line with the findings of [13, 33] who argued that classification of crops as men or women's crops can no longer based on a gender division of labor given that different crops have different labor requirements.

Factors affecting men and women participation in bean production activities

The study also examined the factors that drive gendered participation rates in bean activities during any given bean production season. By summing up the individual activity participation weighted scores, the WGPI (dependent variable) was constructed for men and women. General exploratory data analysis was conducted to determine the distribution of the data for the continuous variables like age, plots, acres and distance, and those that did not fit a normal distribution were transformed before being subjected to further analysis (regression analysis). Multicollinearity was checked using pairwise correlation tests, and variables that were highly correlated, such as size of land, were dropped. Indeed, the mean variance inflation factor (VIF) for both women and men was <10, indicating the absence of problems of multicollinearity (Table 4).

The results of the regression analysis are presented in Table 4. Among the farmer-specific variables, the study found statistical evidence that age of both women and men, having family members in the working age bracket and number of times beans are consumed in a week have significant effects on production participation intensity. Age of women was positively associated with increasing women's participation intensity by 4.6%. It is hypothesized that as women grow older they tend to participate in more bean production activities. This concurs with the findings of Okoye et al. [34] of age being a positive driver in participation in agricultural activities. On the contrary, age of men was associated with decreasing men efforts geared toward bean production by 5.4%. Regardless of the gender of bean grower, having more family members in the working age bracket increases the probability of participating by 0.7% and participation intensities by 2.7 and 5.8% for women and men, respectively. Household size affects family labor supply for production and post-harvest handling [25, 26, 35]. A larger household provides cheaper labor and produces more output in absolute terms such that the proportion sold remains significantly higher. Consistent with the literature reviewed on women concern for household food security [12], there is no doubt that the number of bean meals is associated with increasing women probability of participating in bean production by 0.3 and 1.3% of the participation intensity.

As far as the farm-specific characteristics were concerned, a number of bean plots operated, intercropping

Table 4 Factors affecting gendered participation in bean production activities: Tobit regression (dependent variable = weighted gender participation index)

Explanatory variables	Women			Men		
	Coefficient (SE)	Marginal effects		Coefficient (SE)	Marginal effects	
		Probability of participating	Intensity of participation		Probability of participating	Intensity of participation
Farmer/household						
Household size	0.036 (0.023)*	0.007	0.027	0.069 (0.025)***	0.007	0.058
Dependency ratio	0.290 (0.193)	0.055	0.214	−0.152 (0.220)	−0.015	−0.128
Age[a]	0.063 (0.029)**	0.012	0.046	−0.064 (0.020)***	−0.006	−0.054
Bean consumption	0.017 (0.009)*	0.003	0.013	0.003 (0.011)	0.000	0.002
Farm specific						
Bean plots[a]	0.062 (0.094)	0.012	0.046	0.172 (0.108)*	0.017	0.145
Bean acres[a]	−0.065 (0.048)	−0.012	−0.048	0.051 (0.055)	0.005	0.043
Intercropping	0.083 (0.078)	0.016	0.061	0.146 (0.089)*	0.014	0.122
Distance to plot[a]	−0.109 (0.033)***	−0.021	−0.081	−0.059 (0.038)*	−0.006	−0.049
Capital/institutional						
Group membership[b]	0.091 (0.078)	0.017	0.068	−0.027 (0.096)	−0.003	−0.022
Crop income[a]	−0.045 (0.041)	−0.009	−0.033	0.030 (0.046)	0.003	0.025
Farming[b]	0.104 (0.157)	0.020	0.077	0.508 (0.126)***	0.050	0.427
Distance to market	−0.004 (0.002)**	−0.001	−0.003	0.003 (0.002)	0.000	0.002
Education	−0.018 (0.006)***	−0.003	−0.013	0.006 (0.004)	0.001	0.005
Quintile 2	−0.104 (0.083)	−0.020	−0.077	−0.022 (0.097)	−0.002	−0.018
Quintile 3	−0.064 (0.086)	−0.012	−0.047	−0.163 (0.097)*	−0.016	−0.137
Bean attributes						
Yield[b]	0.095 (0.086)	0.018	0.070	0.103 (0.103)	0.010	0.087
Color[b]	−0.245 (0.116)*	−0.046	−0.181	−0.366 (0.134)***	−0.036	−0.308
Taste[b]	0.027 (0.074)	0.005	0.020	−0.027 (0.081)	−0.003	−0.023
Marketability[b]	0.238 (0.082)***	0.045	0.175	0.167 (0.118)	0.016	0.140
Constant	3.895 (0.625)***			2.756 (0.702)***		
N	626			500		
Chi^2 (13)	68.81			56.40		
Prob > Chi^2	0.000			0.000		
Log likelihood	−762.695			−623.493		
Mean VIF	1.18			1.23		

*, **, *** Significance of coefficients at 10, 5 and 1% levels, respectively

[a] Logarithm

[b] Dummy variable

beans and average distance from homesteads to plots significantly affected the participation rate of men and women bean farmers. Increasing the number of bean plots operated by men by one plot increases the likelihood that men would participate in bean production by 1.7% and increase the intensity of participation by 14.5%. A close look at intercropping of beans with other crops revealed that once the beans were intercropped, it would increase the likelihood that men would participate in bean production by 1.4% and increase their participation intensity by 12.2%, and this is a good indicator that men will avail more time to bean production if they are intercropped to maximize output from the plots. This is in line with the findings of [30] in Tanzania, Malawi and Zambia where beans are also majorly intercropped and rarely planted as a sole crop to spread the risks if farmers were to lose from any of the crops. As expected, distance negatively affected the gender participation in bean production. One-kilometer increase in distance to bean plots reduces the participation intensities of women and men, by 8.1 and 4.9%, respectively. It further reduces the likelihood that both women and men would participate in bean production by 2.1 and 0.06%, respectively. This corroborates [25, 26, 36] that women are more

disadvantaged by the long distances to farms compared to men.

Among the capital endowment and institutional variables, farming as a primary occupation, distance to market, education and asset index had significant influence on participation rates of bean farmers. All other things equal, a man whose primary occupation is farming is 5% more likely to participate in bean production and will 42.7% participate more in bean production than their counterparts. This could partly be attributed to the fact that once farming is the main source of income for men, it will tend to occupy most of their time hence increasing participation. This is in line with the finding s of [34] who found farming as an occupation as an influential factor in men participation in Nigerian agricultural production. Distance to market has a negative association to women in bean production [26, 27]. A woman farmer who spends more additional minutes of walking to the market has a 0.1% lower probability of participating and is expected to participate 0.3% less in bean production. This could partly be attributed to the cultural norm that forbids women from riding bicycles, one of the commonest transport means in the study area or lack of means of means to transport to easily access the market. The number of years women spend in school has a negative effect on participation intensity of women in bean production. An additional year of schooling reduces the probability of participating by 0.3% and participation intensity by 1.3%. This is in agreement with the findings of [35, 36] that being more educated increases opportunities for employment elsewhere thus reducing participation and intensity of participation. Thus, the more educated women are, the less likely they will engage in bean production. Asset-based quintiles that farmers fall in had negative significant effects on men participation in bean production. Men who belong to the richest (highest) quintile had 13.7% lower probability of participating in bean activities as compared to those in the lowest quintile, and they are expected to participate 13.7% less in bean-related activities if they decided to grow beans. This is clear indication that as beans enters the market for sale, rich farmers will leave the crop for the poor ones which may constrain on the available resources. This corroborates with the findings of [11, 19] of the variation in gender division of labor when crops shift from food to profit.

The role of crop attributes in bean production cannot be underestimated as they could influence participation based on what attributes a farmer considers key in selecting bean varieties to grow. These are also indirectly attributed to the market class of seed that farmers will always go for. The color of beans had 18.1 and 30.8% negative influence on participation intensities of both men and women, respectively. Market classification of some beans being popular and other unpopular has always been based on their color. The marketability trait of beans was associated to have a positive influence on women participation potential in bean production. A woman farmer who perceives a particular bean variety to be highly marketable has 4.5% higher probability of participating in its production and is expected to participate 17.5% more in its production. This is a good indicator that women will avail more time to bean production if they are highly marketable to maximize output from the plots. It also implies that denying women opportunity to market beans can lead them to withdrawing their labor and thus limiting bean production.

Conclusions and policy implications

While many believe that bean is a women's crop, this study examined the extent to which bean is regarded a women's crop using men and women perceived participation in bean production and found no empirical evidence to support the notion. We found evidence that bean cannot be regarded as a 'women's crop' based on gender participation intensities since there was no activity that was solely done by only men or only done by women. We can evidently draw three conclusions. First, beans cannot be classified as a women's crop since men also offer support in a number of bean-related production activities, more especially those that require more energy. All activities are done by both men and women regardless of the cropping pattern. Thus, we should not always make inferences in guiding policy making by relating beans to be purely a women's crop but rather target both men and women in bean production. Second, in terms of the perceived farmers' participation, women participated more in most of the activities though some were mostly dominated by men.

Third, the participation rates in bean activities vary between men and women, and this is greatly attributed to factors like age, intercropping, distance to bean plots, farming as a primary occupation, wealth index, crop attributes, number of times beans are consumed among others. Specifically, the color of beans reduced participation of both men and women in bean production in the study area. There is need to conduct participatory bean varietal selection from markets backward to farmers and variety selection using feedback from consumers. Since the number of times beans were consumed in a typical week was key in women participation, there is need to promote early maturing beans to ensure both food and income security. The significance of farming as a primary occupation for men and marketability attributes for women increasing their participation in bean production also needs not to be under looked. There is need to make farming a more lucrative venture through institutional

innovations (bean processors) that can assure markets and prices for producers. This will motivate women to offer more labor and effort for bean production. Finally, the study finds that women do hand-in-hand bean production activities with men. We can ably conclude that bean is not really a women's crop as literature suggests because both men and women participate in bean production. We observe increasing men efforts in activities like weeding, threshing, winnowing and sorting which were traditionally considered women's activities. Indeed, this ought to reduce on women work load for better returns from the crop. In order to close the gender gap in bean production, there is need to target both men and women with gender interventions and address issues of traditional norms of beans being a women's crop.

We acknowledge that other activities like marketing, decision making and processing of beans would be important in classifying crops as either men's or women's, but the study did not have empirical data to test this. Further studies on marketing, income control and use may be definitive in showing who really owns the beans and distinguish between ownership and participation. Further exploration of whether bean is a woman's crop using qualitative methods would help to yield qualitative information on the subject. The study majorly focused on participation intensities where beans were mainly intercropped, and there is need to refocus on examining what would happen if the beans were in pure stand. There is also need to investigate how the income from beans is used by both men and women.

Abbreviations

CIAT: International Center for Tropical Agriculture; NaCRRI: National Crops Resources Research Institute; NARO: National Agriculture Research Organization; IDRC: International Development Research Center; ACIAR: Australian Centre for International Agricultural Research.

Authors' contributions

FN conceived the study, analyzed data, drafted the manuscript and coordinated the write-up. JN reviewed the manuscript from time to time and proposed the appropriate methodology. MAU coordinated the write-up. PA designed the study, collected, analyzed data and reviewed manuscript. EK supervised all stages of the study. EB reviewed data analytical methods and reviewed the manuscript. IJM, GN and RK conceived, designed the study and collected data. All authors read and approved the manuscript.

Author details

[1] Legumes Programme, National Crops Resources Research Institute (NaCRRI), P. O. Box 7084, Kampala, Uganda. [2] International Development Research Center (IDRC), P.O. Box 62084 00200, Nairobi, Kenya. [3] International Center for Tropical Agriculture (CIAT), P.O. Box 6247, Kampala, Uganda. [4] International Center for Tropical Agriculture (CIAT), P.O. Box 1269, Kigali, Rwanda. [5] Mukono Zonal Agriculture Research and Development Institute (MUZARDI), P.O. Box 164 Mukono, Uganda.

Acknowledgements

The study findings presented in this paper were implemented by National Crops Resources Research Institute (NaCRRI) as part of the "Precooked Bean" Project Activities that were funded by IDRC under the CultiAF project. The authors would like to thank IDRC and ACIAR for the funding, the reviewers and participants of the "Precooked bean" write shop that was held in Machakos Kenya for their comments on the earlier version of this paper.

Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

Data that support findings of this study are available from authors upon reasonable request.

Funding

The study was funded by IDRC and ACIAR under Cultivate Africa's Future (CultiAF) project. The funding body through the project officer reviewed and proposed the appropriate methodology that was followed by the study.

Received: 1 November 2016 Accepted: 24 February 2017
Published online: 06 March 2017

References

1. Raney T, Doss C, Anríquez G, Croppenstedt A, Gerosa S, Lowder S, Matuscke I, Skoet J. The role of women in agriculture. ESA Working Paper No. 11-02. Rome: Food and Agriculture Organization; 2011. www.fao.org/economic/esa.
2. Larochelle C, Katungi E, Beebe S. Disaggregated Analysis of Bean consumption demand and contribution to household food security in Uganda. Descriptive report No.1, January 2015. Study conducted by the International Center for Tropical Agriculture and Virginia Tech in partnership with the Pan African Bean Research alliance.
3. Kilimo Trust. Development of inclusive markets in agriculture and trade (DIMAT): the nature and markets of bean value chains in Uganda, 2012.
4. Ugen M, Nkalubo S, Rubyogo JC, Bebe S. Common bean. In: Monyo ES, Gowda CLL, editors. Grain legume strategies and seed Roadmaps for selected countries in sub- Saharan Africa and South Asia, 2014. Tropical Legumes II Project Report. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). pp. 139–149. ISBN 978-92-9066-559-5.
5. Orr A, Tsusaka TW, Kee-Tui SH, Msere WH. What do we mean by 'women's crops'? Commercialization, gender, and the power to name. J Int Dev. 2016;. doi:10.1002/jid.3224.
6. Tsusaka WT, Orr A, Msere WH, Kee-Tui SH, Maimisa P, Twanje HG, Botha R. Do commercialization and mechanization of a "women's crop" disempower women farmers? Evidence from Zambia and Malawi. In: Selected paper prepared for presentation for the 2016 Agricultural & Applied Economics Association, Boston, July 31–August 2.
7. FAO "production data 2012". http://faostat.fao.org.
8. Haggblade S, Dewina R. Staple food prices in Uganda. In: Prepared for the COMESA policy seminar on variation in staple food prices: causes, consequence and policy options, under the African Agricultural Marketing Project (AAMP), 25–26 January 2010, Maputo, Mozambique.
9. Klapper LF, Parker SC. Gender and the business environment for new firm creation. World Bank Res Obs. 2011;26(2):237–57.
10. Cook K. Agriculture has a woman's face in Uganda. USAID, July 2010; IEHA Gender Assessment: Uganda.
11. Njuki J, Kaaria S, Chamunorwa A, Chiuri W. Linking small holder farmers to markets, gender and intra-household dynamics: dose the choice of the commodity matter? Eur J Dev Res. 2011;23(3):426–43.
12. Doss C. Designing agricultural technology for African women farmers: lessons from 25 years of experience. World Dev. 2001;29:2075–95.
13. Tsusaka TW, Msere HW, Siambi M, Mazvimavi K, Okori P. Evolution and impacts of groundnut research and development in Malawi: an ex-post analysis. Afr J Agric Res. 2016;11(3):139–58.
14. Carney J, Watts M. Manufacturing dissent: work, gender and the politics of meaning in a peasant society. Africa. 1990;60(2):207–41.
15. Carney J, Watts M. Disciplining women? Rice, mechanization, and the evolution of mandinka gender relations. Signs. 1991;16(4):651–81.

16. Dolan CS. The good wife: struggles over resources in the Kenyan horticultural sector. Dev Stud. 2001;37(3):39–70.
17. Kumar SK. Adoption of hybrid maize in Zambia: effects on gender roles, food consumption, and nutrition. Research Report No. 100. Washington, DC: International Food Policy Research Institute; 1994.
18. Fischer W, Qaim M. Linking smallholders to markets: determinants and impacts of farmer collective action in Kenya. World Dev. 2012;40(6):1255–68.
19. Forsythe L, Posthumus H, Adrienne M. A crop of one's own? Women's experiences of cassava commercialization in Nigeria and Malawi. J Gend Agric Food Secur. 2016;1(2):110–28.
20. Padmanabhanan MA. The making and unmaking of gendered crops in Northern Ghana. In: Paper presented at conference on International Agricultural Research for Development, Berlin, October 5–7, 2004.
21. Carr RE. Men's crops and women's crops: the importance of gender to the understanding of agricultural and development outcomes in Ghana's central region. World Dev. 2008;36(5):900–15.
22. Chayal K, Dhaka BL, Suwalka RL. Analysis of the role performed by women in agriculture. Humanit Soc Sci. 2010;5(1):68–72.
23. Okonya JS, Kroschel J. Gender differences in access and use of selected productive resources among sweet potato farmers in Uganda. Agric Food Secur. 2014;3(1). doi:10.1186/2048-7010-3-1.
24. Emeya S. Role of women in agricultural activities in Abua-Odual local government area of rivers state, Nigeria. World Rural Obs. 2014;6(2):1–6.
25. Alene A, Manyong V, Omanya G, Mignouma H, Bokanga M, Odhiambo G. Smallholder market participation under transactions costs: maize supply and fertilizer demand in Kenya. Food Policy. 2008;33:318–28.
26. Nakazi F, Sserunkuuma D. Factors affecting the decision and extent of rice-milling before sale among Ugandan farmers. Asian J Agric Rural Dev. 2013;3(8):576–83.
27. Bellemare FM, Barrett BC. An Ordered Tobit model of Market participation: evidence from Kenya and Ethiopia. Amer J Agr Econ. 2006;88(2):324–37.
28. Greene W. Functional forms for the negative binomial model for count data. Econ Lett. 2008;99:585–90.
29. Lemlem A, Bishop-Sambrook C, Puskur R, Tesema E. Opportunities for promoting gender equality in rural Ethiopia through the commercialization of agriculture: improving productivity and market success of Ethiopian farmers project. Working Paper No. 18. Nairobi: International Livestock Research Institute; 2010.
30. Birachi E. Value chain analysis of bean in eastern and southern Africa: building partnerships for impact through research on sustainable intensification of farming systems. 2012. www.africarising.net.
31. Andersson K, Bergman LJ, Chiwona-Karltun L. Gender dynamics in cassava leaves value chains: the case of Tanzania. J Gend Agric Food Secur. 2016;1(2):84–109.
32. Ahmad N, Hussain A. Women's role in forestry: Pakistan agriculture. Islamabad: Agriculture Foundation of Pakistan; 2004. p. 79–81.
33. Enete A, Nweke F, Tollens E. Contribution of men and women to food crop production labour in Africa: information from COSCA. Outlook Agric. 2002;31(4):259–65.
34. Okoye BC, Abass A, Bachwenkizi B, Asumugha G, Alenkhe B, Ranaivoson R, Randrianarivelo R, Rabemanantsoa N, Ralimanana I. Effect of transaction costs on market participation among smallholder cassava farmers in Central Madagascar. Cogent Econ Financ. 2016;4:1143597.
35. Damisa MA, Samndi R, Yohanna M. Women participation in agricultural production: a probit analysis. J Appl Sci. 2007;7:412–6.
36. Oladejo JA, Olawuyi SO, Anjorin TD. Analysis of women participation in agricultural production in Egbedore local government area of Osun State, Nigeria. Int J Agric Econ Rural Dev. 2011;4(1). http://www.ijaerd.lautechaee-edu.com