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Gender Analysis of Sweet Potato Production in Osun State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author FIO designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author SBF managed the literature searches, author ROB analysed the data and author FOO interpreted the results. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

Aims: The research investigated the determinants of gender differentials in the output of male and female sweet potato farmers in the study area. Specifically, the study examined the socio economic characteristics of the sweet potato farmers, gender levels of potato production, the efficiency estimates of the farmers and factors that determine gender outputs in the study area.
Study Design: Cross-sectional study.
Place and Duration of Study: Osun State Agricultural Development Programmes (OSADEP) between April 2010 and September, 2011.
Methodology: The sampling frame for this study is the sweet potato farmers in Osun State, Nigeria. The sample of 16 respondents were randomly selected from five (5) Osun State Agricultural Development Programme (ADP) zones giving a sample size of 80.Primary data were collected with the use of structured questionnaireand personal interviews. The data collected were analysed using descriptive statistics and Cobb-Douglas production function.

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Results: The result suggests that Land clearing, preparation and ridging were found to be done by 90%, 87.5% and 93.8% of the male and 12.5%, 35.0% and 10.0% of the females, respectively. The analysis of the mean output in kg per hectare of the male and female sweet potato farmers shows the difference in the mean output. The efficiency distribution shows that male operate at the efficiency range lower than that of the females. The study reveals that women are more interested and committed to sweet potato farming. Farm size, quantity of input, depreciation, age, education, farming experience and care economy were found to affect output of all the respondents.
Conclusion: It is therefore pertinent that policy makers should pay attention to the female sweet potato farmers as they are found to be more productive, since it was revealed that the female produced more output than their male counterparts. This implies that the female took sweet potato farming more seriously and did not play a supportive or complimentary role to their male counterparts.

Keywords: Gender; efficiency; sweet potatoes; Cobb-Douglas.

1. INTRODUCTION

Food which is a basic necessity of every human being is scarce in its provision; and the provision is a source of concern to both man and woman [1]. Household food security is very important as the women and the men have different but complimentary roles and responsibilities in securing nutritional well-being for all members of the household and the community [2]. Complementary roles are evident in all activities revolving around sweet potato *(Ipomoea batatas)* production especially in some states in Nigeria. Sweet potato is a creeper of the *convolvulaceae* family. It originated from Central America and is widely grown as important staple food in most parts of the world [3].

Presently, Nigeria is the number one producer of sweet potato in Africa with annual output of 3.46 million metric tons [3] and globally the second largest producer after China. The crop is grown for both human and animal consumption. It is the only crop among the root and tuber crops that has a positive per capita annual rate of increase in production in sub-Saharan Africa [4]. Gender participation is a term that describes the roles and activities of men and women according to traditions and beliefs of a particular culture. Buckland [5] a number of new programmatic and funding initiatives targeting female farmers have centered on assumptions of potential farm and nonfarm gains by improving women's ability to access resources [6,7,8].

In most developing countries men and women participate in traditional agriculture performing different roles. These roles are gender specific, complimentary and reciprocal in natural activities like bush clearing, land preparation, harvesting, processing and marketing [9]. Tewe et al. [4] reported that if the contribution of men and women are taken into account equitably when allocating productive resources, agricultural production can be on the increase, women are involved in the production and processing of certain food crops such as cassava, sweet potatoes, maize, yam, melon etc. and are also responsible for weeding, harvesting, transporting processing, storage and marketing of their crops.

The problem of declining crop productivity in Nigeria is not expected given various interventions by government. Farmers output still fall below 60 percent irrespective of the interventions and to enhance this, the means of production (i.e. technology) should be

improved as well as other factors that support farmers output should be given adequate attention [10,11].

Gender inequality remains a problem that has characterized the Nigerian agricultural climate. In Southern part of Nigeria women are meant to do most of farm work and have ownership of the farms while in the Northern part, men do most of the farm work and ownership of farms. Given that gender roles are culture specific, it was observed that in the middle belt region of Nigeria women make ridges and mounds while in the eastern part of the country that is certainly a job for men [12]. Gender responsibilities and difference have not been adequately considered by policy makers and extension workers in many developing countries. Gender differences have implication for farming responsibilities as it influences the farming activities performed. The allocation and distribution of farm incentives are done with gender bias [13]. Policy makers and administrators work with baseless assumption that women play supportive role to the men who are the actual farmers [14].

Women farmers like their male counterpart, need all the necessary training and support to enhance their output [15]. In their paper, the study did not compare the efficiency of the output of the male and female farmers which thus created a gap to be filled. The transformation of traditional or peasant sweet potato farming of which women are of utmost importance to increase output is pertinent. Hence the study therefore made gender analysis of Sweet Potato production in Osun State, Nigeria with the view to analyzing the socio-economic characteristics of the respondents, ascertain various activities performed by male and female sweet potato farmers, analyze the mean output of the male and female sweet potato farmers in the study area, examine the differences in the efficiencies of male and female sweet potato farmers and to determine the factors affecting the output of the male and female sweet potato farmers.

1.1 Theoretical Framework

A stochastic production function is given by

$$Yi = f(Xij\ \beta) \exp(Vi\text{-}Uj),\ = 1, 2, \ldots\ldots\ldots\ldots n \quad (1)$$

where Yi is output of the i-th farm, Xi is the vector of input quantities used by the i-th farm, β is vector of unknown parameters to be estimated; $f(\ )$ represents an appropriate function (e.g. Cobb Douglas, translog, etc). The term Vi is a symmetric error which accounts for random variation in output due to factors beyond the control of the farmer e.g. weather, disease outbreaks, measurements errors, etc, while the term Uj is a non negative random variable representing inefficiency in production relative to the stochastic frontier. The random error Vi is assumed to be independent and identically distributed as N $(0, 6u^2)$ random variables independent of the U is which are assumed to be non-negative truncation of the N$(0, 6u^2)$ distribution (i.e. half-normal distribution) or have exponential distribution [16]. The stochastic frontier was independently proposed by Aigner et al. [16]. The technical efficiency of an individual farmer is defined in terms of the ratio of the observed output to the corresponding frontier output given the available technology [17].

$$\text{Technical efficiency (TE)} = Yi/Yi^* = f(Xi, \beta) \exp(Vi\text{-}Ui)/ f(Xi, \beta) \exp(Vi) = (\exp)(-Ui) \quad (2)$$

Where Yi = observed Output
Yi* = Frontier Output

The parameters of the stochastic frontier production function are estimated using the maximum likelihood method.

1.1.1 The empirical model

The economic model commonly used to determine the relationship between the various factors and the output in agriculture is production function model. The production function of any farmer is determined by resource availability of the farmer. In agriculture, the production inputs consist of land, labour and capital as the basic factors of production. The expected relationship between output and land is that as more land is brought under production, output is increased. To find out the impact of these factors on farm level production of sweet potatoes on both male and female small-scale farmers in Osun state, the functional relationship is specified as

$$OUTPUT=f(FAMS, LAB, VINES, CAPDEPR, AGRCHEM, \mu) \quad (3)$$

Among the various functional forms for analyzing production functions, double-log gives the best fit and is the best [18]Eze et al, 2010 and [19]Goni et al, 2007). The econometric model is specified using the double-log Cobb-Douglas production function as follows:

$$\ln OUTPUT = \ln\beta 0 + \ln\beta 1\ FAMS + \ln\beta 2\ LAB + \ln\beta 3 VINES + \ln\beta 4\ CAPDEPR + \ln\beta 5\ AGRCHEM + Vi - Ui$$

Where,
OUTPUT = Sweet Potatoes output (in kilograms)
FAMS = Farm size (in acres)
LAB = Labour quantity (in man-days)
VINES = Potatoes vines in Kg
CAPDEPR = Depreciation of Capital
AGRCHEM = Agrochemicals used in Naira
Vi = Random error
Ui = Technical inefficiency

1.1.2 Determinants of technical efficiency

In order to determine factors contributing to the observed technical efficiency, the following model was formulated and estimated jointly with the stochastic frontier model in a single stage maximum likelihood estimation procedure using the computer software frontier version 4.1 [20](Coelli, 1996) as follows:

$$TE = a0 + a_1Z_1 + a_2Z_2 + a_3Z_3 + a_4Z_4 + \ldots\ldots\ldots a_7Z_7 \quad (4)$$

Where TE = Technical efficiency of the i-th farmer
Z_1 = Level of education of the farmers (years)
Z_2 = Age of farmers (Years)
Z_3 = Farming Experience (Years)
Z_4 = Frequency of contact with Extension Agents
Z_5 = Marital Status

Z_6 = Credit (₦)
Z_7 = Membership of farmers association/cooperatives (dummy)

While a0, a1 a2 ……a_7 are the parameters to be estimated.

2. METHODOLOGY

Osun state was selected purposively based on the dominance of sweet potato farmers in the area. A two stage sampling technique was used in selecting 80 respondents. In stage one, the 5 agricultural zones in the state were selected for ease of administering the questionnaire. In stage two, 16 respondents were randomly selected from each zone from the list of potato farmers provided by the Osun State Agricultural Development Programme (OSADEP) Staffs. A structured questionnaire was developed based on the objectives of the study to collect information from the respondents. Cross-sectional data were collected from these samples in 2010/2011 cropping season. The data analyses were carried out with descriptive statistics and Cobb-Douglas production function.

3. RESULTS AND DISCUSSION

The result of the socio-economics characteristics of the respondents in (Table 1) shows that the mean age of the female sweet potato farmers (53.90) are more than the mean age of their counterparts (52.60) with the youngest age of 22 years and the oldest of 74 years. It was discovered that about 65% of the farmers are within the age range of 41 and 55 years, 20% are above 55 years while 15 % are below 41 years. This result indicates that most of the farmers are still in their productive years. It was also noticed that most of the young adults are not actively involved in the production of sweet potato in the study area which might be due to rural urban drift. This situation is most common with the male farmers than their female counterparts with the aim of getting more lucrative jobs in cities rather than farming in the villages. This result has policy implication in Nigeria that has been recognized to have high rural-urban migration. The number of rural inhabitants that migrate to cities with hope of overcoming powerlessness consistent with rural life is unprecedented [21]. Majority of the male farmers had spent an average of 10 and half years in school while the female farmers had only spent an average of 4 years in school. The result implied that majority of these sweet potato farmers did not have the quality education necessary for efficient performance in their chosen farming career and also a reflection of quality of labour. In the same manner, the number of hours spent on care economy (taking care of home and children) is much more than that of the male counterpart. This invariably reduces the quality time they would have given to farm work. This may therefore be responsible for low level of innovation and technology adoption by the farmers and possibly failures of keeping good records.

The average family size for male and female sweet potato farmers is 7 and 6 respectively constituting mainly family members whose age are below 18 years. It is believed that production increases if there are more members of the household within the productive age of 18-40. Family size is an important source of family labour since it implies a reduction in the cost of hired labour. The mean years of experience for the two categories are high enough to categorize them as being expert in the production of sweet potato in the study area. This result implies that the farmers were experienced and not just amateurs. The average land size cultivated by male and female sweet potato farmers is 2.6ha and 2.0ha respectively. About 65% of the respondents cultivated below this average, which implies that

they grow sweet potato on small scale, and the likely implication of this is low productivity. Women generally own less land and the land they have is often of lower quality than the land owned by men. According to the Bach and Andersen [22], women in Africa only own 1 per cent of the land and they have to contend with limited access to financial and technical resources.

Table 2 shows that majority of the male sweet potato farmers 72% were involved in land clearing activities while only 10% of the female respondents were also involved. Land preparation was done by 70% of the male and 28% of the female respondents. Ridging was done by 75% of the males and 8% of the females. This is in line with the findings of Tewe et al. [4] (2003) in the study of trends in Sweet potato Production, Utilization, and Marketing in Nigeria in which it was revealed that land clearing and preparation for sweet potato production was done mostly by men. Planting was done by 15% of the males and 76% of the females. About 22% and 55 % of male and female respectively participated in weeding. Majority of the males (76%) were involved in harvesting while 22% of the females were also involved in harvesting. In marketing activity, 27% of the males were involved whereas 62% of the females were into sweet potato produce marketing. The results indicated that the gender participation in marketing activity of sweet potato is still at the rudimentary stage. The result revealed also that majority of the farmers are peasants and with very few in commercialize operations.

Table 1. Mean values of socio economic characteristics of the respondents

Items	Male	Female	Both sexes
Age (years)	52.60	3.90	53.25
Land area (ha)	3.62	3.32	3.32
Labour (man-days)	19.30	13.40	13.40
Education (years)	10.54	4.23	7.39
Family size (No)	7.40	6.8	14.20
Fertilizer (Kg)	766.53	346.84	556.69
Planting material (₦)	25,436.00	19, 324.00	22, 380.00
Capital (₦)	55,334.00	28,657.00	41, 995.50
Farming experience	8.00	6.50	7.25
Tractor use	40%	10%	25%
Loan recipient (%)	73%	68%	70%
Cooperative members	68%	90%	79%
Care economy:			
hours spent on the farm/day	6.00	3.30	4.65
hours spent on children	2.00	5.00	3.50
hours spent on food making/water fetching	.30	6.30	3.50

Source: Field survey, 2011

The results from Table 3 show that women's lack of access to finance is also due to factors such as lack of collateral, complicated administrative procedures, inadequate loan sizes and interest rates, are some of the major factors affecting and limiting the investment and productive capacity of women potato farmers as well as their ability to finance other basic needs. The availability of adequate and well-targeted resources will help women farmers increase their productivity, providing more food for families and reducing the demand for imports. Examples of ways to help women include expanding their access to credit and inputs, as well as technical assistance. This strategy has big payoffs. The analysis in Table 4 shows that there was a higher output of sweet potatoes from female farmers than male farmers because women are the major producers of sweet potato in the study area. One

possible reason for this may be that female owned farms are mostly rented one, while male owned farms are mostly inherited. Female rented land for commercial purposes, so they may have more incentives to work and to get benefits from the rented land. On other hand, male owned farms which are mostly inherited, they may cultivate for household consumption since they have higher percentage of dependents adults in the household making a large total number of family size. By these estimates, agricultural productivity would rise if women farmers' access to inputs, credit and technical assistance were equalized with men's.

Table 2. Distribution of activities performed by the respondents

Activities performed	Male	Female
Land clearing	72 (90)	10 (12.5)
Land preparation	70 (87.5)	28 (35.0)
Ridging	75 (93.8)	8 (10.0)
Planting	15 (18.8)	76 (95.0)
Fertilizer application	38 (47.5)	72 (90)
Weeding	22 (27.5)	58 (72.5)
Harvesting	76 (95)	22 (27.5)
Marketing	27 (33.8)	62 (77.5)

Source: Field survey, 2011
Note: Multiple responses were observed
percentages are in parenthesis

Women farmers took sweet potato farming as a business while the men were involved either as helpers to the woman or to assist the household consumption. It was observed that a little number of male took sweet potato farming as a serious one. This result is in sharp contrast with the assumption that women only play supportive roles in farming business [23]. Cooperatives societies have a role to play in alleviating the problem of agricultural funding, and paving the way towards recovery that is socially and economically sound and sustainable. Where access to credit is becoming restricted, cooperative can continue as providers of financial services. Where public service delivery is jeopardized as a result of crisis-induced cuts in funding and spending, cooperative can play a bridging role as service providers (e.g. health cooperatives), while at the same time providing employment opportunities to women and men. The availability of fund encourages them to acquire more land for farming.

From Table 4, the total output in naira per year for the male and female sweet potato farmers sampled are ₦8, 327,443 and ₦12, 336,472 respectively. The mean output in naira for the male and female sweet potatoes farmers sampled is ₦208, 186 and ₦308, 411 respectively.

The Female farmers realized better output than the males, to further substantiate this fact; Table 5 shows the percentages of the male and female farmers who attained certain levels of efficiency represented by the ranges quoted. The Table shows the productivity estimates

of the male sweet potato farmer with a minimum value of 0.100, mean value of 0.541, and the maximum value of 0.963.The range of the efficiency estimates shows that about 48 percent of the estimates have less than 0.50. The percentage of 12.5 and 7.5 of the estimates are within the range of 0.60-0.69 and 0.70-0.79 respectively. Also, 7.5 percent and 5.0 percent efficiencies estimates were within the ranges 0.80-0.89 and >0.89 respectively for male gender. The distribution refers that majority (48%) of the male sweet potato farmers lie within the efficiency rating of <0.50 in contrast with female farmers with high efficiency rating of 38 % within the ranges of 0.7 - 0.79. The productivity efficiency estimates of the female sweet potato farmers shows the minimum value of 0.100 and the mean value of 0.796 with a maximum value of 0.963. About 5.0 percent of the farmers have efficiency value of less than 0.50. Also, 12.5%, 37.50%, 25% and 12.5% of the female sweet potato farmers had efficiency values with ranges of 0.60-0.69, 0.70-0.79, 0.80-0.89 and >0.89 respectively. This distribution inferred that the majority were within the efficiency rating of 0.70-0.79. The result implied that the female farmers are efficient operators in sweet potato farming than the males.

Table 3. Distribution of respondents according to farm inputs sources

Characteristics	Male		Female	
	Freq.	Percent	Freq.	Percent
I. Source of Planting Materials				
Purchased	5	12.5	3	7.5
Own Farm	18	45.0	22	55.0
Friends and relatives	6	15.0	2	5.0
Friends and relatives/Own farm	11	27.5	13	32.5
Total	40	100.0	40	100.0
II. Source of Land				
Inherited	19	47.5	1	2.5
Purchased	2	5.0	0	0.0
Rent	11	27.5	21	52.5
Family land	8	20.0	18	45.0
Total	40	100.0	40	100.0
III. Source of Capital				
Personal savings	14	35.0	19	47.5
Cooperative society	8	20.0	3	7.5
Cooperative/personal savings	5	12.5	6	15.0
Friends and relatives/personal	11	27.5	12	30.0
savings	2	5.0	0	0.0
Banks	40	100.0	40	100.0
Total				
IV. Fertilizer usage				
Used	18	45.0	8	20.0
Not- used	22	55.0	32	80.0
Total	40	100.0	40	100.0

Source: Field survey, 2011

Table 4. Distribution of the sweet potato producers' output per hectare

Variables (Kg/ha)	Male	Female
Number of respondents (n_i)	40	40
Total Output (X1)	8,327,443	12,336,472
Mean Output (X2)	208186.08	308411.80

Source: Field data, 2011.

Table 5. Frequency distribution of male and female gender efficiency

Technical efficiency	Male		Female	
	Frequency	Percentage	Frequency	Percentage
<0.50	19	47.5	02	5.0
0.5 - 0.59	08	20.0	03	7.5
0.6 – 0.69	05	12.5	05	12.5
0.7 – 0.79	03	7.5	15	37.5
0.8 – 0.89	03	7.5	10	25.0
>0.89	02	5.0	05	12.5
Total	40		40	
Min	0.100		0.100	
Max	0.963		0.963	
Mean	0.541		0.796	

Source: Field Survey, 2011

The result from Table 6 shows that there are minimum likelihood of the estimate of the Cobb-Douglas function for female gender output, the coefficient of farm size, quantity of sweet potato stems in Kg, quantity of agrochemical and depreciation of capital. The coefficient of farm size, quantity of sweet Potato vines and quantity of agrochemical in Kg were all significant at 1% probability level and were all positively related with sweet potato output. This was buttressed by the elasticity values of 4.63, 4.93, and 184 respectively. These values indicated that the household sweet potato productivity is still at the second stage of production and increasing the use of any of these inputs will result to greater future productivity among the female sweet potato farmers.

The efficiency factors affecting the productivity of the female farmers included farming experience, marital status, number of extension visits and household size. Age related negatively with efficiency of productivity but was not significant. The result implied that old age will reduce efficiency. The analysis further shows that, the coefficient of marital status was significant at 1% probability level and has positive relationship with efficiency. That implied that marital status is an incentive in terms of increased labor force to sweet potato production in the study area. Also the years of experience was significant at 1% probability level and has positive relationship with efficiency of productivity. This shows that increase in the years of experience increase productivity efficiency. Also number of extension agent visit and household size were also significant at 1% probability level and both had a positive relationship. Thus, the more an extension agent visit the farmer with productive innovations and that is adopted by the farmer the productive and efficient the farmer will be.

Table 6 further showed that there is minimum likelihood of the estimate of the Cobb-Douglas function for male gender output**.** The coefficient of farm size and quantity of sweet potatoes vine input available were significant at 1% probability and they were all positively signed.

This implied that increase in the availability of farm land and sweet potatoes vine input for the farmers, leads to increase in the farm output. Furthermore, labor (man days) was significant at 1% probability and negatively signed. The implication of these results is that increase in the number of labor man days will lead to decrease in productivity because of over utilization of resources which invariably increases the production cost. The efficiency factor affecting the productivity includes the age, education status, marital status, extension visits and household size. Age related negatively with the efficiency of productivity and it is significant at 1% productivity level. The implication is that ageing is in consonance with inefficiency. Educational status, marital status, and number of extension visits and household size related positively with efficiency productivity. The implication is that increase in these factors will result to increase efficiency in productivity of the male sweet potato farmers in the study area.

Table 6. Cobb-Douglas Frontier Function Estimation of Female and Male Gender Output

Production function	Parameter	Male		Female	
		Coefficient	t-value	Coefficient	t-value
Constant	b0	35.871***	42.602	14.636***	2.131
Farm size	b1	0.463***	19.292	3.854***	3.913
Labour (Mandays)	b2	-1.167	-0.251	13.295***	-5.030
Quantity of sweet Potatoes vines in Kg	b3	4.927***	7.436	10.644***	6.856
Depreciation of Capital	b4	-0.546***	-37.655	-2.498***	-37.655
Distance travelled	b5	- 0.416	-0.472	- 0.416	-1.250
Quantity of Agrochemicals	b6	3.844***	6.958	0.864***	6.971
Efficiency factor					
Educational status in Years	Z_1	0.075	0.113	-0.411	-3.385
Age in years	Z_2	-0.056	-0.182	-0.044	-3.385
Farming experience	Z_3	0.382***	3.897	0.255***	2.257
Extension visits	Z_4	8.498***	12.334	8.191***	8.175
Marital status	Z_5	6.212***	8.406	9.997***	12.296
Household size	Z_6	11.221***	12.334	12.011***	13.541
Credit availability	Z_7	1.625	0.449	0.772	0.193
Membership association	Z_8	0.624	0.269	0.626	1.122
Diagnostic statistics					
Sigma	σ^2	3.614**	5.387	28.665**	9.743
Gamma	γ	0.500		0.500	
Log likelihood function	η	-110.314		-110.314	
LR test		12.003		12.006	

Source: Field survey, 2011

****, **, *= 1%, 5%, 10% level of probability*

4. CONCLUSION AND RECOMMENDATIONS

The study has highlighted that there are gender differential (s) in the output of male and female sweet potatoes farmers in the study area. It was revealed that the female produced more output than their male counterparts. This implies that the female took sweet potatoes farming more seriously and did not play a supportive or complimentary role to their male

counterparts. The women were found to be more technically efficient, this may be as a result of their commitment to sweet potatoes farming.

The problem of gender inequality was address by directing attention toward resources for women farmers. The deterioration of conditions for granting credit with the situation of women in the agricultural sector or the access of credits to women was already complicated. Many women who have had to rely on personal savings, with all its limitations, for productive investment, could be affected by the credit crunch due to tightening of it downstream. Both the male and female participated in sweet potatoes farming activities. The males were more involved in sweet potatoes farming activities such as land clearing, land preparation and ridging while the female were more involved in sweet potatoes farming activities such as planting, harvesting and marketing.

It is therefore, recommended that agricultural extension agencies should intensify efforts in disseminating improved production technologies especially to the women to support their efforts in sweet potatoes farming. Government should provide sweet potatoes farming inputs and ensure that female farmers get a fair share of the inputs. There should be more investment in sweet potatoes farming since it as a source of self employment especially for women, as this will help the government in the fight against gender imbalance and shortage of employment. In order to achieve rural development in Nigeria, which is to increase rural productivity and income, there is need to enhance the quality of life of women sweet potatoes farmers and meet the extension service needs of women farmers in sweet potatoes production.

Strengthening the role of women in agriculture and ensuring decent work for a growing number of women is one step to help economies to get back on track. This would help to reach the goal of halving the share of poor people. The list of possible measures includes: increasing women's access to farming land and fertilizers, credit, and education; increasing women's participation in decision-making; and strengthening women's role within the family. All these measures are crucial to guaranteeing high productivity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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