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Impact of women's access to and control over land on food security of agricultural households in rural Benin

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Abstract
Land constitutes an important capital (natural capital) for people that draw their livelihoods from agriculture. However, women are mostly left behind in terms of land rights in Sub-Saharan Africa. In this paper, we explore the impact of women's access to and control over land on per capita food expenditures and food security status. The paper focusses on agricultural households from rural areas in Benin using data from the Survey of the Overall Analysis of Vulnerability and Food Security carried out in 2013. After cleaning the dataset, it includes 4,371 usable observations. Women's access to and control over land is captured by a binary variable. In 21.19% of the agricultural households included in the sample, women were owner of their personal land. Per capita food expenditures and food security status of the households appear to be positively related to women's access to and control over land, supporting the importance of women empowerment with regards to land rights in improving food consumption and food security. Within a period of 30 days, farm households with women having access to and control over land have on average per capita food expenditures higher of 828.25 CFA F compared with their counterparts. The findings suggest that to improve food security the Beninese government should enact policies that facilitate women's access to and control over land and their effective access to resources such as labor, and fertilizers (going beyond assuming a unitary model of the household).

Key words: Access to land, control over land, food consumption, food security, agricultural households

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1. Introduction
Land constitutes an important capital (natural capital) for people that draw their livelihoods from agriculture. However, women are mostly left behind in terms of land rights in Sub-Saharan Africa (SSA). For instance, men dominate women in decision-making with regard to access to and control over land. Nevertheless, women play a key role in farming in SSA, and their access

to and control over land influence positively food supply, farm household income and welfare including food security status. Women are involved in agriculture in many ways; as illustration, they source labor to activities such as seeding and planting, harvesting, and transporting production from farms to the dwellings (Alemu, 2015). Indeed, access to and control over land is important in sustaining livelihoods, resource management and overall rural development (Wineman and Liverpool-Tasie, 2017; Alemu, 2015; Alston, 2014; Kongolo, 2012; Meinzen-Dick *et al.*, 1997). Nonetheless, empirical analyses are needed to test the validity of this assertion, to guide policy-makers on relevant policies to be implemented to improve food security status and in-fine to reduce poverty and inequality, especially in rural areas, heart of the agricultural production.

Agricultural development is the engine to promote economic development and food security in Benin, a developing country located in West Africa. Benin is a coastal country with a population amounting to 10,008,749 inhabitants in 2013, according to the fourth census of the population. It should be noted that the total land size of the country is 114,763 square kilometers. Agriculture contributes about 35%% of the gross domestic product (GDP), and 70% of employment (République du Benin, 2014). In addition, SSA in general, and Benin in particular are characterized by high level of poverty. Furthermore, in SSA the number of undernourished people increased from 174 million in 1990-92 to 218 million in 2014-16 (OECD and FAO, 2016). It is crucial to address poverty and food insecurity in rural areas of SSA to boost the economic development of those areas and thus the overall economic development of the countries through inter-sectoral linkages. Moreover, Meinzen-Dick *et al.* (1997, p. 1304) argued that "if poverty reduction is an important goal, we need to look beyond productivity/yield impacts, to also know the effect of gender differentials in property rights on the control of income, as opposed to just the level, and the effect of income control on welfare".

Women's land rights is found to promote development by empowering women, increasing productivity, and improving welfare (Allendorf, 2007). Indeed, women empowerment is considered as crucial in improving livelihoods and in boosting economic development. Land ownership constitutes a means of women empowerment by increasing women's security and affects their control over household decisions, including those related to food and nutrition (Agarwal, 1997; Haddad *et al.*, 1997). Actually, when women have control over resources, those resources are more likely to be used to the benefit of children and others (Allendorf, 2007). It should be noted that women empowerment goes beyond the view of considering the household as a "unitary entity" which was introduced by Becker (1965) and assumes in modeling that household members seek to maximize utility on the basis of a set of common preferences represented by an aggregate utility function, and a common budget constraint (Agarwal, 1997). Indeed, household members may have different preferences, different budget constraints and may be different in terms of control over resources. Subsequently, a sift away from a unitary model of the agricultural household toward a model focused on individuals within households as producers and on individually managed plots is observed in research on gender and agriculture in recent years (Seymour, 2017). Seymour (2017) found that closing the empowerment gap between men and women in Bangladesh would lead to an increase in technical efficiency by 2.2%.

In this paper, we explore the impact of women's access to and control over land on per capita food expenditures and food security status. Women's access and control over land is captured by

ownership of the land they cultivate within the households regardless of the nature of property rights (*de jure* or *de facto*).

The remainder of the paper is organized as follows. Section 2 reports the material and methods used. The results as well as these discussion are presented in Section 3, while section 4 is relative to the conclusion and policy implications.

2. Material and methods
2.1. Empirical strategies
Two types of models are estimated in this paper: the model of per capita food expenditures and that of food security status. Actually, food security is captured by per capita food expenditures and a variable related to food security status of the household. The model of per capita food expenditures is specified as follows:

$$Y_i = \beta_0 + X_i'\beta + \alpha W_i + \mu_i \quad (1)$$

where Y_i is the per capita food expenditures of the household i, X_i is the vector of regressors apart from the variable capturing women's access to and control over land, and μ_i is the error term. The regressor of interest is W_i which is relative to women's access to and control over land. Actually, we are interested in the magnitude and the sign of the parameter α. Equation (1) can be estimated by the means of the ordinary least squares (OLS). However, the OLS estimates may be biased, because the variable capturing women's access to and control over land may be endogenous. This likely endogeneity may be taken into account through instrumental variables (IV) techniques. Thus, the paper tests the endogeneity of women's access to and control over land through an IV approach of the model of per capita food expenditures (paying attention to the fact that the treatment is binary to avoid estimating a forbidden regression). To implement the IV technique, there must be at least an instrument which is correlated with women's access to and control over land and contemporaneously uncorrelated with the error term. Ethnicity of the household head is then used as instrument. Indeed, empowering women by giving them the right to control land may vary across ethnic groups. Other regressors of the model include the sex, the education level, and the age of the household head, household size, the number of persons that contribute to household income, livestock ownership, practice of irrigation, and use of improved seeds, herbicides, manure/organic fertilizers, chemical fertilizers and insecticides/fungicides, following the literature on the topic (e.g., Garret and Ruel, 1999).

The other model estimated in the paper is related to the determinants of food security status of the household. This model is specified as follows:

$$Z_i = \gamma_0 + X_i'\gamma + \delta W_i + \varphi_i \quad (2)$$

where Z_i is the food security status of the household i, X_i is the vector of regressors as described above, and φ_i is the error term. Like in the case of per capita food expenditures, the interest is particularly by the side of the parameter δ. The same issue related to the likely endogeneity of women's access to and control over land also holds in equation (2). Thus, IV technique may be used. However, owing to the fact that the dependent variable – the food security status of the household – is categorical, the usual IV method is not applicable. Thus, one has to resort to the special regressor method using Lewbel (2012) approach (Baum, 2012). The same instrument – ethnicity of the household head – is used to implement the special regression. To estimate equation (2) with this technique, the dependent variable must be binary. Therefore, this paper

uses a binary variable of food security status. Accordingly, the dependent variable in equation (2) is described as follows:

$$Z_i = \begin{cases} 1 \text{ if the household is either moderately or severely food insecure} \\ 0 \text{ if the household is either food secure or slightly food insecure} \end{cases}$$

The description of the variables used in the paper is presented in Table 1.

Table 1. Definition of variables

Variables	Description	Unit
Per capita food expenditures	Per capita food expenditures of the households	Local currency (CFA F)[a]
Food security status	Food security cluster of the household	0=Food secure/slightly food insecure and 1=Moderately food insecure/severely food insecure
Sex	Sex of household head	1=Male and 0=Female
Education	Education of household head	1=None 2=Primary 3=Secondary 4=University
Household size	Number of individuals in the household	Number of persons
Irrigation	Practice of irrigation	0=No and 1=Yes
Seeds	Use of improved seeds	0=No and 1=Yes
Herbicides	Use of herbicides	0=No and 1=Yes
Organic	Use of manure/organic fertilizers	0=No and 1=Yes
Fertilizers	Use chemical fertilizers	0=No and 1=Yes
Insecticides	Use of insecticides/fungicides	0=No and 1=Yes
Livestock	Livestock ownership	0=No and 1=Yes
Age	Age of household head	Years
Active	Number of household members that contribute to household income	Number of persons
Women own land	Women's are owner of land	0=No and 1=Yes
Ethnicity	Ethnicity/nationality	1=Adja 2=Bariba 3=Dendi 4=Fon 5=Yoa and Lokpa 6=Betamaribe 7=Peulh 8=Yoruba 9=Other ethnicities 10=Bordering countries

2.2. Data

The paper focusses on agricultural households from rural areas in Benin using data from the Survey of the Overall Analysis of Vulnerability and Food Security carried out in 2013 from February to March by the National Institute of Statistics and Economic Analysis (Institut National de la Statistique et de l'Analyse Economique – INSAE). The survey included 15,000 households from 750 villages/neighborhoods and is representative at the national, departmental and communal levels. After cleaning the dataset, it includes 4,371 usable observations (agricultural households from rural areas). In the survey women's access to and control over land

is captured by ownership of women of the land they cultivate; thus a binary variable. However, this variable does not provide information on the quality of the land women own.

3. Results and discussion

Before estimating the models, descriptive statistics on the variables are presented (Table 2). The monthly per capita food expenditures of the households amounted to 6,039 CFA F, which is quiet low, compared with the $1.25 per day poverty line. The average value of the per capita food expenditures masks the disparities across households as the minimum is zero while the maximum is 75,000 CFA F. The minimum of zero indicate that some households rely solely on self-consumption. The survey revealed that 16.62% of the households surveyed are either moderately or severely food insecure. In 21.19% of the agricultural households included in the sample, women were owner of their personal land. This statistic suggests that in most of the households women lack access to and control over resources such as land. Therefore, something must be done to effectively empower women in terms of access to and control over land in rural areas of the country.

Table 2. Descriptive statistics

Variables	Average/Proportion	Std. Dev.	Minimum	Maximum
Per capita food expenditures	6039.048	4927.90	0	75000
Food security status				
Food secure/slightly food insecure	83.38	-	-	-
Moderately food insecure/severely food insecure	16.62	-	-	-
Sex (Female)	0.12	-	0	1
Education				
None	0.76	-	0	1
Primary	0.17	-	0	1
Secondary	0.07	-	0	1
University	0.002	-	0	1
Household size	5.78	2.95	1	28
Irrigation	0.12	-	0	1
Seeds	0.07	-	0	1
Herbicides	0.12	-	0	1
Organic	0.17	-	0	1
Fertilizers	0.32	-	0	1
Insecticides	0.13	-	0	1
Livestock	0.61	-	0	1
Age	45.80	14.66	1	120
Active	1.70	0.91	0	12
Women own land	0.21	-	0	1
Ethnicity				
Adja	0.15	-	0	1
Bariba	0.09	-	0	1
Dendi	0.03	-	0	1
Fon	0.35	-	0	1
Yoa and Lokpa	0.05	-	0	1
Betamaribe	0.09	-	0	1
Peulh	0.06	-	0	1
Yoruba	0.11	-	0	1
Other ethnicities	0.06	-	0	1
Bordering countries	0.01	-	0	1

As aforementioned, the likely endogeneity of women's access to and control over land is taken into account in the two econometric regressions. However, the Durbin and Wu-Hausman tests

indicate the non-acceptance of the hypothesis of endogeneity of women's access to and control over land. Owing to this finding, the paper considers women's access to and control over land as exogenous and estimate by OLS the model of per capita food expenditures. Nevertheless, the results of OLS and two stages least squares (2SLS) estimations are reported (Table 3). But, the preferred model is the OLS. It should be noted that the signs of the parameters are the same in the two regressions, but there are differences in the magnitude of the parameters. Women's access to and control over land has positive and significant impact on per capita food expenditures, supporting the importance of women empowerment with regards to land rights in improving food consumption. Within a period of 30 days, farm households with women having access to and control over land have on average per capita food expenditures higher of 828.25 CFA F compared with their counterparts. This finding is in line with the idea that women empowerment in terms of land ownership is a means to improve food and nutrition security of the households (Allendorf, 2007; Agarwal, 1997; Haddad *et al.*, 1997). Female-headed households have per capita food expenditures which are lower than those of male-headed households. Actually, belonging to a female-headed households leads to having per capita food expenditures lower than those of the others of 881.62 CFA F. This suggests that female-headed households lack financial resources to be spent for food purposes. Indeed, in rural Benin female heads are mostly widowed persons. Although Garret and Ruel (1999) found a negative association between female-headed households and nutrition, the effect in their case is not significant.

The findings indicate that formal education level of the household head is important in spending in food. Household heads with secondary education spend more in food compared with those that do not have any formal education level. Actually, education is important in raising awareness on the importance of well feeding household members to avoid diseases. The size of the household is negatively and significantly associated to per capita food expenditures. Indeed, households with more mouths to feed will have low level of per capita expenditures compared with the remaining. This finding is not in line with those of Garret and Ruel (1999) that found mixed results (negative as well as positive). The results also suggest that the households tend to allocate more resources to food as the head become experienced. Thus, through experiences, they learn about the importance of food for health. The practice of irrigation, and the use of improved seeds, herbicides, and manure/organic fertilizers are beneficial in increasing per capita food expenditures. These help farmers to improve farm productivity and in-fine the profitability and then they can devote more resources to food consumption. Conversely, the use of insecticides/fungicides is detrimental for per capita food expenditures. Livestock ownership appears to lead to the increase in per capita food expenditures.

Table 3. Estimation results of per capita food expenditures

Variables	2SLS		OLS	
	Coef.	Robust Std. Errors	Coef.	Robust Std. Errors
Women own land	2263.42**	962.94	828.25***	171.28
Sex: Reference = Female	-1172.12***	266.3	-881.62***	205.99
Education: Reference =None				
Primary	49.14	165.88	91.4	162.21
Secondary	978.82***	280.82	1064.38***	276.45
University	1719.07	1866.31	1666.29	1864.73
Household size	-716.55***	35.5	-725.59***	35.12
Irrigation	874.25***	256.28	994.42***	232.02

Seeds	1594.14***	382.57	1958.74***	331.22
Herbicides	1396.52***	242.21	1484.42***	240.55
Organic	433.31**	211.88	533.76***	201.02
Fertilizers	131.20	151.99	81.65	149.72
Insecticides	-631.87***	233.31	-829.18***	200.00
Livestock	804.45***	144.12	782.40***	142.13
Age	10.77**	4.95	12.05**	4.88
Active	-70.68	72.38	-2.74	64.31
Constant	8476.73***	366.68	8599.64***	350.77
Observations		4368		4371

Note: *, **, *** indicate statistically significance at the 10%, 5%, and 1%, respectively.

Two estimation results are also reported for the model of food security status; special regression using Lewbel (2012) approach and logistic regression (Table 4). The logistic regression is estimated as the test fails to accept the hypothesis of endogeneity of women's access to and control over land. This regression explains the odds of households to be either moderately or severely food insecure. The findings show that the households in which women have access to and control over land are less likely than the remaining households to be either moderately or severely food insecure. This finding confirms that obtained with the model of per capita food expenditures. Thus, women empowerment constitutes an important channel of improving food security status of the households. Female-headed households are 1.40 times more likely to be either moderately or severely food insecure compared with male-headed households. Households whose heads had primary and secondary education level are less likely to be either moderately or severely food insecure than their counterparts that did not have any formal education level. The odds to be either moderately or severely food insecure decrease with household size and the number of individuals that contribute to household income. Households that practice irrigation and those that use chemical fertilizers are 1.26 and 1.49 times more likely to be either moderately or severely food insecure compared with the remaining households, respectively. Conversely, households that used irrigation are found to be less likely to be food insecure compared with the remaining households. Surprisingly, livestock ownership increases the odds to be food insecure.

Table 4. Estimation results of food security status

Variables	Special regression			Logistic	
	Coef.	Std. Errors	Marginal effects	Odds Ratio	Robust Std. Errors
Women own land	-0.22	0.14	-0.01	0.48***	0.06
Sex: Reference = Female			0.03	1.40***	0.17
Education: Reference =None					
Primary	0.13***	0.03	0.005	0.67***	0.08
Secondary	0.12***	0.04	0.004	0.35***	0.08
University	0.11	0.2	0.004	0.45	0.47
Household size	0.02***	0.004	0.001	0.97*	0.02
Irrigation	0.09***	0.03	0.003	1.26*	0.16
Seeds	0.02	0.05	0.001	1.17	0.19
Herbicides	0.08**	0.04	0.003	0.76*	0.12
Organic	0.05*	0.03	0.002	0.91	0.11
Fertilizers	-0.03	0.02	-0.001	1.49***	0.14
Insecticides	-0.01	0.04	-0.0003	0.96	0.12
Livestock	-0.03	0.02	-0.001	1.43***	0.13
Age	-0.003***	0.001	-0.0001	1.00	0.003
Active	0.03**	0.01	0.001	0.77***	0.05
Constant	-0.11**	0.05	-0.004	0.30***	0.06
Observations		4151			4369

Note: *, **, *** indicate statistically significance at the 10%, 5%, and 1%, respectively.

4. Conclusion and policy implications

This paper examined the impact of women's access to and control over land on per capita food expenditures and food security status in rural Benin. Women have access to and control over land in 21.19% of the agricultural households included in the sample. Per capita food expenditures and food security status of the households appear to be positively related to women's access to and control over land, supporting the importance of women empowerment with regards to land rights in improving food consumption and food security. Within a period of 30 days, farm households with women having access to and control over land have on average per capita food expenditures higher of 828.25 CFA F compared with their counterparts. The findings suggest that to improve food security the Beninese government should enact policies that facilitate women's access to and control over land and their effective access to resources such as labor, and fertilizers (going beyond assuming a unitary model of the household). The indicator of women's access to and control over land used does not account for the quality of land, therefore future research should account for that.

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Appendix. First stage of the IV model of per capita food expenditures (Probit)

Dependent variable: Women own land		
	Coef.	Robust Std. Errors
Sex: Reference = Female	0.73***	0.07
Education: Reference =None		
Primary	0.06	0.06
Secondary	0.17*	0.09
University	-0.17	0.52
Household size	-0.02**	0.01
Irrigation	0.21***	0.07
Seeds	0.70***	0.08
Herbicides	0.29***	0.08
Organic	0.38***	0.06
Fertilizers	0.02	0.06
Insecticides	-0.47***	0.08
Livestock	-0.001	0.05
Age	0.003**	0.001
Active	0.13***	0.03
Ethnicity: Reference = Adja		
Bariba	0.14	0.11
Dendi	0.25*	0.15
Fon	0.67***	0.09
Yoa and Lokpa	0.93***	0.12
Betamaribe	0.20*	0.11
Peulh	0.08	0.13
Yoruba	0.75***	0.10
Other ethnicities	0.20*	0.12
Bordering countries	0.59**	0.28
Constant	-1.79***	0.12
Observations	4368	