Understanding Child Nutritional Outcomes of Land Reform Policy in Zimbabwe from a Gender Perspective

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Bringing Rigour and Evidence to Economic Policy Making in Africa

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Abstract

This paper analyzes the effect of land reform policy on child nutrition outcomes in Zimbabwe, and estimates whether the effect differs based on gender of household head. Using nationally representative Rural Livelihoods Assessment Survey data collected in 2017, the study employs an endogenous switching regression model to control for selection bias and endogeneity. The results show that benefitting from land reform increases the likelihood of both stunting and wasting in children. From a gender perspective, the paper provides evidence that benefitting from land reform significantly reduces the likelihood of child stunting in female-headed households. The study recommends that land reform policies should enhance access to land for women as a strategy for reducing child malnutrition.

Key Words: *Land reform, Stunting, Wasting, Treatment effects, ESR model*

1. Introduction

In Zimbabwe, where primary agricultural production (farming) is still the dominant economic activity for the majority of the population, land remains the most important resource for sustaining rural livelihoods, eradicating hunger and poverty, and achieving economic empowerment (Mutondoro et al., 2016; Kurebwa, 2014). Hence the basic linkages between access to and ownership of land, as well as both physical and economic access to food, cannot be ignored. Hence, redistributive policies like land reform, which affect and or change access to and/or ownership of land, are relevant in impacting nutritional outcomes through their direct linkages to physical food access. To a greater extent, access to and control over land determines the struggle for gender equality and equity for women as unequal land rights are perceived to entrench gender inequality and perpetuate poverty, hunger and malnutrition in rural farming households (Verhart et al., 2016; Kurebwa, 2014). Thus, the vast share and majority of food production attributable to women renders them the principal custodians of household food and nutrition security and welfare in rural areas (Verhart et al., 2016).

Despite assuming this role as primary workers of the land and food producers, women continue to be disproportionally affected by poverty, hunger and malnourishment (IDS, 2014). The major reasons for this continued lagging behind and low status of women in society identified in the literature tend to point towards limited access to and control over land. For example, Hove and Nyamandi (2016) pointed out that although women constitute the majority (up to 70%) of agricultural producers in rural areas of Zimbabwe, their access to land and control over proceeds from the land is still very limited. This is despite the Government of Zimbabwe (GoZ) having implemented a series of land reforms aimed at empowering women, among other objectives (ZimVAC, 2017). The latest of these land reforms is the Fast-Track Land Reform Program (FTLRP), first implemented in 2000, which is the land reform policy of interest in this study.

The aim of the FTLRP was to re-indigenize and empower previously marginalized agrarian black Zimbabweans, including women. The FTLRP was also meant to decongest the over-populated communal areas created during the colonial era and to resolve tenure-related issues that surrounded the land question following the country's independence from colonial rule in 1980 (Mutopo, 2014). However, within the FTLRP, the question of gender in land reform, and the discourse around it, has revolved

mainly around women's access to land without necessarily going further to interrogate welfare outcomes, specifically nutrition outcomes at the household level. According to the World Food Program (WFP, 2016), analyses of household food and nutrition security from a gender perspective should also encompass aspects of land access and property rights. It is generally postulated that increasing access to productive resources such as land by rural women represents an empowerment process that can bring about positive impacts for beneficiation outcomes at the household level, particularly with regard to poverty alleviation and food and nutritional security (Mutopo 2014, 2014; WLZ, 2008; ZWCRN, 2008).

Based on the importance of household nutrition outcomes and access to land through land reform policies, the literature on their relationship is still limited, especially in Zimbabwe. To the best of our knowledge, there is no empirical evidence with regard to ascertaining the relationship between access to land, including women's access to land through the land reform policy, and household nutritional outcomes in Zimbabwe. The linkages between access to land (larger landholdings, cultivable, fertile and more productive agricultural land and accompanying secured legal rights of land ownership) as a result of a land reform policy and accruing incomes and household-level food security, have positive ripple effects on household nutritional outcomes. The assumption is that land reform is accompanied by agrarian reforms that are favourable and enabling for smallholder farmers, in terms of input and credit access, output marketing facilities and extension services. Hence, this study sought to analyze the effect of the land reform policy on nutritional outcomes of rural households in Zimbabwe. It does so through an assessment of the impacts arising from their participation in land reform in terms of beneficiation through "access" to and "control over" land resources in their own right or by marriage. The specific objectives of this study were to:

1. Assess the determinants of child nutrition outcomes at the household level as measured by stunting and wasting indicators.

2. Estimate the impact of the FTLRP policy on child nutrition outcomes using stunting and wasting indicators.

3. Estimate and ascertain whether the effect of benefiting from the FTLRP on children's nutrition outcomes (stunting and wasting) varies based on gender of household head.

2. Methodology

Econometric model and estimation

Households included in the survey had the freedom to choose to participate or not participate in the FTLR, i.e., they chose their own treatment conditions rather than being randomly assigned. Hence, there was some form of self-selection. The major challenge that arises is to attribute unambiguously nutrition outcome results to the treatment condition (FTLR beneficiary or non-beneficiary) and not to pre-existing characteristics of the households. This problem is compounded by the possibility of unobserved variables confounding between FTLR participation and the nutrition outcome variables, i.e., an endogeneity problem. In this paper, an endogenous switching regression (ESR) model estimated by using an instrumental variable approach is employed within a production function framework. This model and its variants have been widely applied in the empirical literature (Key et al., 2000; Vance and Geoghegan, 2004; Abu and Issahaku, 2017). The advantage of the model for this study is clear in that it allows for an assessment of factors that affect the likelihood of a household benefiting from land reform and the factors that affect the nutritional outcomes of the households using a production function approach, whilst also controlling for endogeneity and self-selection bias.

Model specification

The measurements of land reform beneficiation and household nutritional outcomes are the basis for the econometric specifications. Land reform beneficiation (L) is conceptualized as two distinct dummy variables indicating: (i) land reform beneficiary (L=1), if a household applied and received land through land reform and, (ii) land reform non-beneficiary (L=0), if it did not acquire land through land reform. Nutritional outcome variables of interest in this study (Y) are child anthropometry indices (HAZ and WHZ).

Following discussions from the literature, we follow previous studies to model land reform (L) beneficiation and nutritional outcomes (Y) as separate models. The following discrete and continuous models are defined:

$$L_i = \alpha + \gamma X_i + \mu_i \quad (1)$$

$$Y_i = \beta + \delta Z_i + \upsilon_i \quad (2)$$

Equations 1 and 2 represent the land reform beneficiation and nutrition outcome models, respectively where: L_i and Y_i are land reform beneficiation and nutritional outcome variables, respectively; X_i and Z_i are exogenous vectors of characteristics hypothesized to influence land reform beneficiation and nutritional outcomes, respectively; α, β, γ, δ are parameters to be estimated; and μ_i, υ_i are error terms.

As Equation 1 is a discrete model, qualitative choice models such as probit and logit are applicable. However, using probit or logit at best returns standalone determinants of land reform beneficiation and nutritional outcomes and thus defeats the purpose of linking land reform beneficiation and nutritional outcomes as this study sets out to pursue. In this case, the ESR is superior to the well-established propensity score matching and treatment effects models for evaluating the impact of land reform policy on nutritional outcomes, as the former would first retain determinants of land reform beneficiation and nutritional outcomes (for beneficiary and non-beneficiary households), and then the effect of land reform policy on nutritional outcomes. The ESR, with a switch in nutritional outcomes and criterion functions specifying to which regime a household belongs, is defined as follows:

$$\text{Regime 1: } Y_{1i} = \delta_1 Z_{1i} + \upsilon_{1i} \text{ if } \gamma X_i + \mu_i > 0 \tag{3}$$

$$\text{Regime 2: } Y_{2i} = \delta_2 Z_{2i} + \upsilon_{2i} \text{ if } \gamma X_i + \mu_i \leq 0 \tag{4}$$

$$L_i = 1 \; if \; \gamma X_i + \mu_i > 0 \text{ and } L_i = 0 \; if \; \gamma X_i + \mu_i \leq 0 \tag{5}$$

where Y_{1i} and Y_{2i} are nutritional outcome indices of land reform beneficiaries and non-beneficiary households, respectively; X_i, Z_i , δ , γ are as defined previously; υ_{1i}, υ_{2i}, μ_i are the respective error terms assumed to have a trivariate normal distribution with mean zero and covariance matrix:

$$\text{Cov } (\upsilon_{1i} , \upsilon_{2i}, \mu_i) = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{1\mu} \\ \sigma_{12} & \sigma_2^2 & \sigma_{2\mu} \\ \sigma_{1\mu} & \sigma_{2\mu} & \sigma_\mu^2 \end{bmatrix}$$

where σ_1^2 and σ_2^2 are variances of the error terms in the nutritional outcome equations; σ_μ^2 is the variance of the error term in the land reform beneficiation equation; $\sigma_{1\mu}$ and $\sigma_{2\mu}$ are the covariance of υ_{1i} and μ_i, and υ_{2i} and μ_i, respectively; σ_{12} is the supposed covariance of υ_{1i} and υ_{2i}. However, σ_{12} is undefined as Y_{1i} and Y_{2i} are not observed simultaneously. We assume $\sigma_\mu^2 = 1$ because γ is estimable only up to a scale factor (Maddala, 1983; Lokshin and Sajaia, 2004). The specification from Equations 3 to 5 ensures the joint determination of land reform beneficiation and its effect on household nutritional outcomes.

The log likelihood function of Equations 3 and 4 is specified as follows:

$$\ln L = \sum_i (L_i\, \omega_i [\ln\{F(\eta_{1i})\} + \ln\{f(\upsilon_{1i} \,/\, \sigma_1) \,/\, \sigma_1\}]) + (1 - L_i)\, \omega_i [\ln\{1 - F(\eta_{2i})\} + \ln\{f(\upsilon_{2i} \,/\, \sigma_2) \,/\, \sigma_2\}]) \quad (6)$$

where $F(.)$ and $f(.)$ are cumulative normal distribution and normal density distribution functions, respectively; ω_i is an optional weight for observation *i*, and

$$\eta_{ji} = \left(\gamma X_i + \rho_j \upsilon_{ji} \,/\, \sigma_j\right) / \sqrt{1 - \rho_j^2}$$

j=1, 2 and ρ_j is the coefficient of correlation between υ_{ji} and μ.

The nutrition outcome in Equations 3 and 4 estimate child nutrition outcomes. The selection in Equation 5 includes one additional variable, age of household head, i.e., the instrument variable, to improve identification. The selection equation is estimated based on all exogenous variables specified in the continuous nutrition outcome equations plus the instrument. The age of the household head is believed to influence the likelihood of participation and beneficiation from land reform, but not to affect the nutrition outcomes directly. The intuition behind the instrument is that younger household heads are more likely to have limited ownership of land as compared to their counterparts and, as such, they are more likely to seek land ownership whenever the opportunity arises and the FTLR did present such an opportunity. However, age of the household head does not affect the household nutrition outcome directly.

The "movestay" command in Stata, developed by Lokshin and Sajaia (2004), implements a full information maximum likelihood simultaneous estimation of Equations 3–5, which yields consistent standard errors. The advantage of this over a single estimation approach (e.g., using a two-step least square or maximum likelihood estimation) is its ability to correct for selectivity bias in nutrition outcome estimates (Lokshin and Sajaia, 2004).

The ESR does not estimate the effect of participation in land reform on nutritional outcomes directly. However, the estimates from the ESR can be used to predict four expected conditional outcomes:

$$E(Y_{1i} \setminus L_i = 1, Z_{1i}\ ) = Z_{1i}\beta_1 + \sigma_1 \rho_1 \phi(\gamma X_i) \,/\, \Phi(\gamma X_i) \quad (7)$$

$$E(Y_{1i} \setminus L_i = 0, Z_{1i}\ ) = Z_{1i}\beta_1 - \sigma_1 \rho_1 \phi(\gamma X_i) \,/\, (1 - \Phi)(\gamma X_i) \quad (8)$$

$$E(Y_{2i} \setminus L_i = 1, Z_{2i}\ ) = Z_{2i}\beta_2 + \sigma_2\rho_2\phi(\gamma X_i) \,/\, \Phi(\gamma X_i) \quad (9)$$

$$E(Y_{2i} \setminus L_i = 0, Z_{2i}\ ) = Z_{2i}\beta_2 - \sigma_2\rho_2\phi(\gamma X_i) \,/\, (1-\Phi)(\gamma X_i) \quad (10)$$

Where Equation 7 is the predicted level of nutritional outcomes of land reform beneficiary households who actually benefited, Equation 8 is if they had not benefited, Equation 9 is if non-beneficiary households had benefited and Equation 10 is non-beneficiary households who did not benefit. From Equations 7–10 we then estimate the expected average treatment effect on the treated (ATT) and the expected average treatment effect on the untreated (ATU) as follows:

$$\text{ATT} = (7) - (8) = Z_{1i}(\beta_1 - \beta_1) + \sigma_1\rho_1(\lambda_1 - \lambda_2) \quad (11)$$

$$\text{ATU} = (9) - (10) = Z_{2i}(\beta_2 - \beta_2) + \sigma_2\rho_2(\lambda_1 - \lambda_2) \quad (12)$$

where, $\lambda_1 = \phi(\gamma X_i) \,/\, \Phi(\gamma X_i)$ and $\lambda_2 = \phi(\gamma X_i) \,/\, (1-\Phi)(\gamma X_i)$. The estimates of Equations 11 and 12 are used to indicate the effect of the land reform policy on nutritional outcomes.

The "msat" command in Stata, developed by Lokshin and Sajaia (2004), estimate all the treatment effects, i.e., ATT, ATU and ATE.

Data

The study uses secondary data collected in 2017 from a cross-sectional, nationally representative sample of agricultural households under a rural livelihoods vulnerability assessment survey conducted by the Zimbabwe Vulnerability Assessment Committee (ZimVAC). The ZimVAC 2017 Rural Livelihoods Assessment Survey collected data from 11,858 households, of which about 33 per cent are female-headed households. The survey collected detailed information on demographics and health, including anthropometric measurements for children, food and non-food consumption expenditure, food security, and shocks and safety nets, among other things. The households are referenced by the farming sector they fall under, which enables grouping them into FTLR beneficiaries and non-beneficiaries.

Variables

Treatment variable

This study used an impact evaluation methodology to estimate the effect of FTLR participation and beneficiation on household nutrition outcomes. The treatment variable is land reform participation and beneficiation. The households were referenced by the agricultural sector they fall under, which enabled grouping the

households into FTLR beneficiaries and non-beneficiaries. This implies that land reform participation and beneficiation is discrete comprising two indicators, 0 and 1, representing FTLR non-beneficiary and beneficiary households, respectively. Households had the freedom of choice of applying for land under the FTLR or not. Hence there was some form of self-selection.

Outcome variables

We used stunting and wasting as indicators of child malnutrition, although stunting is preferred to wasting as it is considered a long-term indicator of child nutritional status relative to wasting, which is a short-term indicator of acute malnutrition (WHO, 1995). Two indices, height-for-age (HAZ) and weight-for-height (WHZ) were constructed and recorded as continuous z-scores, which describe the number of standard deviations by which the child's anthropometric measurement deviates from the median according to the 2006 WHO child growth standard. The z-score cut-off point between -3 and -2 is classified as moderate stunting and wasting, suggesting moderate undernutrition, and a z-score of less than -3 is classified as severe stunting or wasting, which indicates severe undernutrition (WHO and UNICEF, 2009).

Explanatory variables

Variables anticipated to affect the decision to participate in the FTLR and the nutrition outcomes were selected based on land reform and child nutrition studies and theory. A description of the main explanatory variables and their summary and descriptive statistics are provided in Table 1.

3. Results and discussion

Descriptive and summary statistics of household socioeconomic characteristics

Of a sample of 5,441 households, 22% benefitted from the FTLRP, while 78% did not benefit (Figure 1a). Most of the 22% beneficiary households were male-headed (17%), while female-headed households constituted only five per cent (Figure 1b).

Figure 1a: Fast-track land reform beneficiaries

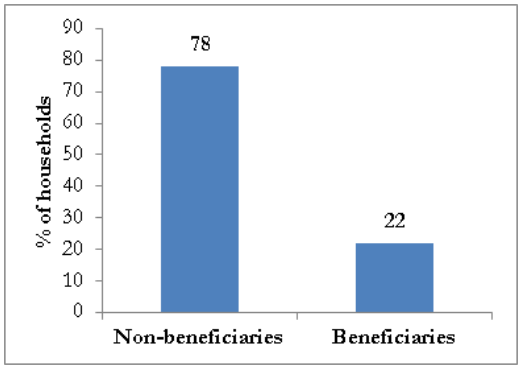

Figure 1b: Fast-track land reform beneficiaries by gender of household head

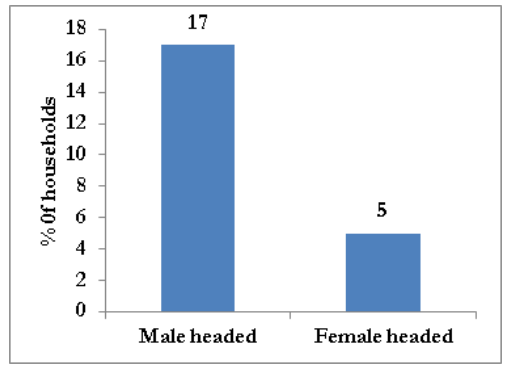

Table 1 presents the t-test comparisons of the means of the main explanatory variables that have been used to compare land reform beneficiaries and non-beneficiary households. There are statistically significant differences in the means of all variables, save for intensity of contact with agricultural extension officers and type of ablution facilities.

Table 1: Description, measurement and summary statistics of main explanatory variables

Variables	Description	Measurement	Non-beneficiaries		Beneficiaries		
			Mean	SD	Mean	SD	t
HHDSIZE	Household size	Number of people	6.2	2.39	5.8	2.39	4.81***
AGEHEAD	Age of household head	Years	47.0	15.94	43.1	14.27	7.77***
SEXHEAD	Gender of household head	1 = if male; 0 = if female	0.7	0.46	0.8	0.44	-5.04***
EDUCHEAD	Education level of household head	1 = if none; 2 = if primary; 3 = if ZJC; 4 = if O-level; 5 = if A-level; 6 = if diploma/certificate after primary; 7 = if diploma/certificate after secondary; 8= if graduate/postgraduate	2.6	1.22	2.7	1.23	-2.65***
MARITALHEAD	Marital status of household head	1 = if married; 0 = otherwise	0.7	0.42	0.8	0.38	-4.46***
LIVESTOCKKEPT	Total number of livestock kept	Number of livestock	14	18.28	12	17.07	2.81***
NUMVISITS	Visit by agricultural extension worker	Number of visits	0.7	2.73	0.7	3.31	-0.38
HDD	Household dietary diversity	Score ranging from 0 to 12	5.7	2.02	6.0	2.07	-4.51***
NUMCROPS	Crop diversification level	Number of crops grown	3.1	1.82	2.4	1.91	11.41***
MAIZE	Maize total yield	Kilograms	564.3	2749.34	1174.8	2686.51	-6.80***
AGRICSALES	Total amount of crop & livestock sales	Value in US$	39.80	243.82	90.40	359.47	-5.64***
OFFFARMSALES	Total amount of off-farm income	Value in US$	63.89	157.33	107.99	273.67	-7.12***
TOTSALES	Total amount of sales	Value in US$	103.69	297.3	198.4	503.89	-8.18***
GVTAID	Government aid received	Score ranging from 0 to 7	1.3	1.28	1.2	1.24	4.47***
NGOAID	Non-governmental organization aid received	Score ranging from 0 to 7	0.6	0.98	0.2	0.66	12.11***
REMITTANCE	Total remittances received	Value in US$	11.3	78.03	7.7	45.08	1.51*
WATERSOURCE	Water source for household use	1 = if protected; 0 = otherwise	0.74	0.44	0.65	0.47	5.64***
TOILETTYPE	Type of toilet used	1 = flush or Blair; 0 = otherwise	0.8	0.49	0.8	0.49	0.17
WATERSAFE	Treatment of drinking water	1 = yes; 0 = otherwise	0.06	0.24	0.08	0.27	-2.21**

Source: ZIMVAC Survey (2017).
* p<0.10, ** p<0.05, *** p<0.01.

Prevalence of malnutrition

Table 2 shows that the prevalence of stunting is 30.7%, and higher among boys (33.6%) than girls (27.7%). Female-headed households have a marginally higher level of stunting in children (31.5%) compared to male-headed households (30.5%). Boy children and children in female-headed households are more vulnerable to stunting as compared to their counterparts. There is not much difference in the prevalence of stunting between beneficiaries (30.7%) and non-beneficiaries (30.8%) of the FTLRP. Conversely, the prevalence of wasting is low (3.8%), with wasting levels slightly higher among boys (3.9%) than girls (3.7%). Female-headed households have a marginally higher level of wasting in children (4.0%) compared to male-headed households (3.7%). Boy children and children in female-headed households are more vulnerable to wasting in comparison to their counterparts. The prevalence of wasting is lower among beneficiaries (2.9%) than non-beneficiaries (4.1%).

Table 2: Descriptive statistics for stunting and wasting

		Prevalence rate	Mean HAZ	t	Prevalence rate	Mean WHZ	t
Land reform regime	Non-beneficiaries	30.8%	-1.25	0.09	4.1%	0.21	-0.74
	Beneficiaries	30.7%	-1.26		2.9%	0.24	
Gender of household head	Male headed	30.5%	-1.25	0.17	3.7%	0.24	1.94**
	Female headed	31.5%	-1.26		4.0%	0.16	
Sex of child	Boys	33.6%	-1.37	-4.06***	3.9%	0.22	0.37
	Girls	27.2%	-1.13		3.7%	0.21	
Total	30.7%	-1.26		3.8%	0.22		

Source: ZIMVAC Survey (2017).
* p<0.10, ** p<0.05, *** p<0.01.

Determinants of child nutrition outcomes

The estimates of stunting and wasting were categorized between land reform beneficiary and non-beneficiary households as presented in Table 3. There are variables in which behaviours are similar (symmetric), while for some they are distinctly different (asymmetric) between the non-beneficiary and beneficiary households. This illustrates the necessity of splitting the sample into the two regimes, thus validating the choice of the ESR.

Table 3: ESR model estimates of determinants of stunting and wasting

Variables	Stunting				Wasting			
	Non-beneficiaries		Beneficiaries		Non-beneficiaries		Beneficiaries	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
HHDSIZE	0.0254	(0.0172)*	-0.0224	(0.0312)	0.0084	(0.0098)	-0.0531	(0.0218)**
SEXHEAD	-0.0655	(0.0792)	0.3161	(0.1881)*	-0.0123	(0.0507)	0.3679	(0.1222)***
EDUCHEAD	-0.0044	(0.0305)	0.0117	(0.0534)	0.0594	(0.0208)***	-0.0462	(0.0369)
LIVESTOCKKEPT	0.0025	(0.0017)*	0.0075	(0.0033)**	-0.0011	(0.0012)	-0.0009	(0.0028)
NUMVISITS	0.0003	(0.0097)	0.0525	(0.0168)***	0.0007	(0.0079)	0.0025	(0.0187)
HDD	-0.0544	(0.0209)***	0.0947	(0.0359)***	-0.0053	(0.0127)	0.1156	(0.0286)***
NUMCROPS	0.0765	(0.0221)***	-0.2168	(0.0467)***	0.0582	(0.0164)***	-0.1849	(0.0369)***
AGRICSALES	-0.0003	(0.0001)**	0.0006	(0.0002)***	-0.0001	(0.0001)*	0.0004	(0.0002)***
GVTAID	0.0201	(0.0289)	-0.0678	(0.0604)	0.0189	(0.0184)	0.0129	(0.0426)
REMITTANCE	0.0002	(0.0005)	0.0012	(0.0011)	0.0001	(0.0003)	0.0008	(0.0005)*
WATERSOURCE	0.2501	(0.0862)***	-0.4546	(0.1638)***	0.1533	(0.0564)***	-0.4877	(0.1094)***
TOILETTYPE	0.0078	(0.0742)	-0.1081	(0.1417)	0.0989	(0.0481)**	0.0204	(0.0991)
WATERSAFE	0.1608	(0.1419)	0.2358	(0.2359)	-	-	-	-
CONSTANT	-2.0489	(0.1958)***	-4.5012	(0.4253)***	-0.6380	(0.1441)***	-1.9130	(0.3147)***
Observations	5438				5417			
Sigma	2.3932	(0.0878)***	3.0048	(0.2043)***	1.5387	(0.0766)***	2.0870	(0.1847)***
Rho	-0.6088	(0.0790)***	0.8615	(0.0458)***	-0.6020	(0.0853)***	0.8818	(0.0322)***
Wald test of indep. eqns.	106.98***				151.45***			
Wald chi2	31.42***				32.95***			
Log pseudo	-14,591.12				-12,194.8			

Source: ZIMVAC Survey (2017).
Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Determinants of stunting

Table 3 shows that the number of livestock kept, number of visits by an agricultural extension worker, amount of remittances received and treatment of drinking water have symmetric effects for both regimes and have the expected positive signs. The number of livestock kept is simultaneously significant in both regimes, while the number of visits by an agricultural extension worker is significant only among the beneficiary households. Additional livestock kept by a household increases the HAZ, thereby reducing stunting. The increase for land reform beneficiary households (0.007) is greater than for non-beneficiary households (0.003). The implication is that increasing the number of livestock kept by a household corresponds to reducing stunting in children. This is consistent with a priori expectation about the effects of this variable, and this finding highlights the role of livestock ownership, as a source of protein, income and draught power, in reducing the prevalence of stunting. As expected, an additional visit by an agricultural extension worker to a household increases the HAZ by 0.05 for land reform beneficiaries. The implication is that increased access to extension services corresponds to a reduction in stunting for children, particularly among land reform beneficiaries. Agricultural extension is critical for relaying relevant information, including nutrition-sensitive messages, to rural farming households (Mutabazi, 2011).

The amount of agricultural sales, household dietary diversity (HDD) score, number of crops grown and type of water source used by the household show distinctly different behaviours between the beneficiary and non-beneficiary regimes. An increase in the amount of agricultural sales increases HAZ among the beneficiaries and, therefore, means less stunting. However, HAZ decreases with an increase in the amount of agricultural sales among the non-beneficiaries, hence there is more stunting. The positive effect of agricultural sales in beneficiary households is as expected. This suggests that beneficiary households with higher income levels are associated with low stunting prevalence. Higher income earnings are synonymous with more buying power, implying more disposable income to afford a wide range of diverse foods. The negative effect of agricultural sales in non-beneficiary households is unexpected. A possible explanation is that there might be trade-offs in expenditure, whereby additional income is spent on other basics like school fees at the expense of food items and or healthcare.

Determinants of wasting

The number of visits by an agricultural extension worker, amount of remittances received, amount of government aid received and type of toilet used by the household have symmetric effects for both regimes and have the expected positive signs. The amount of remittances received by the household positively influence WHZ in both the beneficiary and non-beneficiary regimes, although it is only significant among the beneficiaries. This implies that a higher amount of remittances received by

a household increases WHZ, thereby reducing the prevalence of wasting. This is consistent with a priori expectations about the effects of this variable, emphasizing the role of remittances as a source of income and in reducing the prevalence of wasting through the income effect. Households that use an improved toilet type, such as flush or Blair, have their children's WHZ increased by 0.02 points and 0.09 points in the beneficiary and non-beneficiary regimes, respectively, and hence there is less likelihood of wasting than in households that use other types of ablution facilities such as open defecation. Although the use of an improved toilet type reduces the likelihood of wasting in both regimes, it is only significant among the non-beneficiaries. This implies that improved access to safe sanitation and hygiene-related services are necessary in enhancing child nutrition outcomes.

Turning attention to asymmetric behaviour, the amount of agricultural sales, number of crops grown, type of water source used, household size, sex of household head, education level of household head and HDD show asymmetric behaviours between land reform beneficiaries and non-beneficiaries. The amount of agricultural sales, number of crops grown and type of water source used by the household show distinctly different behaviours between the beneficiary and non-beneficiary regimes and they are also simultaneously significant in both regimes. An increase in the amount of agricultural sales increases WHZ among the beneficiaries and, therefore, less wasting. However, WHZ decreases with an increase in the amount of agricultural sales among non-beneficiaries, meaning more wasting. The positive effect of agricultural sales in beneficiary households is as expected. This suggests that beneficiary households with higher income levels are associated with low wasting prevalence. Higher earnings increase household purchasing power, which is important for child nutrition outcomes.

Six factors that are significant for child nutrition outcomes are household characteristics including household size and sex of household head, level of crop diversification, HDD, amount of income received from household farming activities and the type of water source used by the household for drinking and cooking. Access to extension services and number of livestock kept by the household are additional significant determinants for stunting, while education level of household head, amount of remittances received by the household and type of toilet used emerge as additional significant determinants only for wasting. The results clearly support the notion that household head characteristics, crop diversification, number of livestock kept, dietary diversity, income levels, and extension as well as water and sanitation services, are important determinants of child nutrition outcomes.

Effect of land reform beneficiation on stunting and wasting

The results of the estimation of the effect of land reform beneficiation on stunting and wasting are displayed in Table 4.

Table 4: Estimates of treatment effects on stunting and wasting

Nutrition outcomes	Treatment effects		
	ATT	ATU	ATE
Stunting	-1.2***	-2.6***	-2.3***
Wasting	-0.7***	-1.9***	-1.6***

Source: ZIMVAC Survey (2017).
* p<0.10, ** p<0.05, *** p<0.01.

The ATE shows that in households that benefitted from land reform, the children's HAZ and WHZ are 2.3 and 1.6 points, respectively, lower than households who did not benefit. This implies an increased likelihood of stunting and wasting among children in beneficiary households. The ATT shows that in households that benefitted from land reform, the children's HAZ and WHZ are 1.2 and 0.7 points, respectively, lower than if they had not benefitted. This means that their beneficiation from land reform reduced HAZ and WHZ more than if they had not benefitted. The implication is that children in beneficiary households are worse off, as benefitting from land reform increases the likelihood of stunting and wasting. Conversely, the ATU indicates that in households who did not benefit from land reform, the children's HAZ and WHZ would have been 2.6 and 1.9 points, respectively, lower than their current situation of being non-beneficiaries. The implication is that children in non-beneficiary households would have been worse off and more stunted and wasted had their households benefitted from land reform. Clearly, these results imply that land reform has not been beneficial to child nutritional outcomes as measured by the level of stunting and wasting, as all the estimates (ATT, ATU and ATE) are negative and significant. However, these findings are contrary to the findings of Kosec and Shemyakina (2017) and Siddiqui et al. (2017), who found that land reform has a positive impact on child nutritional outcomes in India. Accordingly, we conclude on the basis of all the estimates (ATT, ATU and ATE) that beneficiation to land reform has not been beneficial to reducing stunting and wasting in children.

Gender perspective of land reform beneficiation on stunting and wasting

Considering the nutritional outcomes from a gender perspective, the results of the effect of land reform beneficiation on stunting and wasting are displayed in Table 5. The treatment effects were estimated using the ESR model on subsamples of male-headed and female-headed households separately.

Table 5: Estimates of treatment effects on stunting and wasting by gender

Household head type	Stunting			Wasting		
	Treatment effect			Treatment effect		
	ATT	ATU	ATE	ATT	ATU	ATE
Male headed	-1.3***	-2.4***	-2.1***	-0.9***	-1.7***	-1.5***
Female headed	0.4***	0.2***	0.2***	-0.2***	-2.6***	-2.2***

Source: ZIMVAC Survey (2017).
* p<0.10, ** p<0.05, *** p<0.01.

Effect of land reform beneficiation on stunting and wasting by gender

The ATT for male-headed households is -1.3 with regard to stunting and -0.9 for wasting, which means that among male-headed households that benefitted from land reform, their children's HAZ and WHZ are 1.3 and 0.9 points, respectively, less than if they had not benefitted. This shows that male-headed households' participation in land reform reduced the children's HAZ and WHZ than if they had not benefitted, implying an increased likelihood of child stunting and wasting. Conversely, the ATT for female-headed households is 0.4 for stunting and -0.2 for wasting, which means that among the female-headed households that benefitted from land reform, the children's HAZ is 0.4 points more, while WHZ is 0.2 points less than if they had not benefitted. This shows that their participation in land reform increased their children's HAZ but reduced their WHZ than if they had not benefitted. The implication is a reduction in the likelihood of child stunting in female-headed households.

The ATU for male-headed households is -2.4 with respect to stunting and -1.7 with respect to wasting, which means that among male-headed households that did not benefit from land reform, the children's HAZ and WHZ would have been 2.4 and 1.7 points less, respectively, had they benefitted. This implies that children in non-beneficiary male-headed households would have been worse off or more stunted and wasted had their households benefitted from land reform. However, the ATU for female-headed households is 0.2 and -2.6, respectively, for stunting and wasting, which means that among female-headed households that did not benefit from land reform, the children's HAZ and WHZ would have been 0.2 points more and 2.6 points less, respectively, than their current situation of not having benefitted. This implies that children in non-beneficiary female-headed households would have been better off or less stunted had their household benefitted from land reform.

The ATE values of -2.1 and -1.5 with respect to stunting and wasting, respectively, for male-headed households indicate that for those households that benefitted from land reform, the children's HAZ and WHZ, respectively, would have been 2.1 and 1.5 points less than for male-headed households that did not benefit. This implies an increased likelihood of stunting and wasting among children in male-headed households who benefitted from land reform as compared to those households who

did not. Hence, beneficiation through land reform has no benefit to child nutrition outcome as measured by level of stunting and wasting in male-headed households. However, among female-headed households, the ATE values of 0.2 and -2.2 with regard to stunting and wasting, respectively, show that the children's HAZ and WHZ are 0.2 points more than and 2.2 points less than female-headed households who did not benefit. This implies a reduced likelihood of stunting and increased likelihood of wasting among children in female-headed households that benefitted in comparison to those that did not participate.

Therefore, from a gender perspective, it is clear that the treatment effect of access to land through land reform on child stunting is positive and beneficial among female-headed households, but negative and not beneficial among male-headed households. An explanation for this result could be that land access could be a more important limiting factor in female-headed households than in male-headed households. Hence, increased access to land for female heads would inevitably lead to significant and positive effects on child stunting outcomes as compared to their male counterparts.

4. Conclusions and policy implications

This paper examined the effect of land reform policy, specifically the FTLRP, on child nutrition outcomes in Zimbabwe from a gender perspective. The results of the ESR model estimation show that improved land access or beneficiation through the land reform policy and households' child nutrition outcomes are endogenous variables. A treatment effects estimation has shown that land reform beneficiation increases the likelihood of both stunting and wasting. It emerged that in households that benefitted from land reform, the children's HAZ and WHZ were significantly lower than their non-beneficiary counterparts. Thus, beneficiation through land reform alone is not sufficient to reduce both stunting and wasting in children. From a gender perspective, the paper provides evidence that land reform beneficiation reduces the likelihood of child stunting among female-headed households, while it increases the likelihood of child stunting in male-headed households. Specifically, children's HAZ in female-headed households that benefitted from land reform was significantly higher than their non-beneficiary counterparts, while HAZ for male-headed households that benefitted from land reform was significantly lower than their non-beneficiary counterparts. In comparison with male-headed households, children in female-headed households tend to benefit more from the land reform policy.

Land reform has been found to have no significant benefit in terms of reducing child wasting in both male- and female-headed households. The reduction in WHZ is even greater among children in female-headed households compared to those in male-headed households. Therefore, should land reform policies aim to achieve improved nutrition security among other objectives, they should be supported by complementary policies and/or programmes that take into account the important determinants of child nutrition outcomes. Such interventions, which enhance women's access to land, promote education, increase household income levels, improve crop and dietary diversification, enhance access to extension, encourage livestock rearing, as well as improve access to safe and clean water, sanitation and hygiene services should seriously be taken into consideration.

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