Do remittances and/or public transfers matter for agricultural investments and food security outcomes among rural households in Zimbabwe?

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Abstract

This study investigates whether private transfers, specifically, migrant remittances, and public transfers, matter for agricultural and food security outcomes of rural households in Zimbabwe, using descriptive statistical methodologies on a recent household survey. The findings reveal agriculture-related public transfers have a positive association with crop diversification. There is also a notable positive association between agriculture-related public transfers and the use of modern agricultural inputs, particularly inorganic fertilizer and improved/hybrid seed. The results show that food-related public transfers are rightly channelled towards the poorest households. Also, households headed by men are more likely to diversify crop production, use modern agricultural inputs, and own livestock of higher value, relative to female-headed households. International migrant remittances are found to not have any statistically significant relationship with the agricultural outcomes of rural households, perhaps owing to the small number of households receiving them. Domestic remittances are shown to have a negative association with crop diversification but a positive association with the use of modern agricultural inputs, particularly inorganic fertilizer and herbicides. Thus, domestic remittances seem to have an opposing effect to public transfers when it comes to crop production, but complement public transfers when it comes to input use. On average, the results suggest no relationship between the receipt of public transfers or remittances and the dietary diversity of households, highlighting the need to further explore how better nutritional outcomes can be achieved in rural Zimbabwe.

Key words:

Remittances; public transfers; agricultural investments; food security

1. Introduction

The agricultural sector in Zimbabwe is dominated by smallholder farming which is regarded as a key driver of pro-poor economic growth and sustainable development, poverty reduction, employment creation, and food and nutrition security (FAO 2016). The Transitional Stabilisation Programme (GoZ 2018a) highlights that the contribution of agriculture to Zimbabwe's GDP is anticipated to grow from 12.4% to 16.4% between 2018 and 2020 due to strategic and innovative policy and practice interventions under the banner of 'Smart Agriculture'. This growth sets the right pathway for a positive economic and food security outlook given the poor performance of the Zimbabwean agricultural sector in recent years (AfDB 2019). Various constraints have inhibited this performance, including limited access by rural households to agricultural finance, and consequently quality inputs and modern technology. Food security thus remains a policy concern. The African Development Bank (2019) postulates that putting in place mechanisms that improve access to finance by smallholder farmers has a multiplier effect on increased crop input use, adoption of agriculture technologies, and crop diversification.

Following a prolonged liquidity crisis in Zimbabwe, financial flows towards agricultural growth have weakened, resulting in low agricultural production and high food insecurity. Thus, the government has directed its policy towards improving access to agricultural finance under the Transitional Stabilisation Programme and new National Agricultural Policy Framework (2018-2030) (Go Z 2018b) which identify public, private and diaspora remittances as key funding sources to support the growth of the agricultural sector. Key programmes under public support include Command Agriculture and the Presidential Input Support Programme. On the other hand, private funding has focused on commercial bank financing and contract farming.

Migrant remittances have also contributed significantly towards agriculture development in Zimbabwe. Remittances are generally acknowledged to contribute significantly to poverty alleviation in recipient countries (Bracking and Sachikonye 2006, 2010), and have become Zimbabwe's second largest source of national income after exports of goods and services. However, there is limited consensus on the exact relationship between remittances, agricultural outcomes, and food security.

Against this backdrop, this study analyses the contribution of remittances and public transfers in promoting household agricultural and food security outcomes in Zimbabwe. The research considers whether migrant remittances and public transfers matter for: (i) agricultural input use, (ii) crop diversification/specialisation, and (iii) the value of livestock owned. The research also explores remittance receipts, public transfers, and the food security of rural households using dietary diversity scores and the share of the household budget allocated towards food as proxies for food security.

The findings of the research suggest that public transfers correlate positively with input

use. In particular, agriculture-related public transfers have a strong and positive correlation with inorganic fertilizer use and improved/hybrid seed use. Agriculture-related public transfers also have a strong and positive correlation with crop diversification. On the other hand, food-related public transfers have a negative correlation with crop diversification. Food-related public transfers are also shown to be received by the poorest households, those with a large share of their expenditure allocated to food consumption. This is in contrast to remittances from abroad which are seen to be received by richer households. Domestic remittances are shown to have a negative association with crop diversification but a positive association with modern input use, particularly inorganic fertilizer and herbicides.

The paper proceeds as follows: Section II lays out the theoretical framework and provides a brief review of the literature. Section III presents and briefly discusses the data and summary statistics for the key variables used in the econometric analysis. In section IV the econometric methodologies used to undertake the analysis are discussed. Section V presents and discusses the empirical results. Finally, Section VI provides some concluding remarks and policy recommendations.

2. Theoretical framework and literature review

Several theories have been postulated to create a framework for understanding the effects of migration and remittances on smallholder agricultural households. Most of these have attempted to model how losses in labour and the impact on agricultural productivity can be partly offset by remittance income from the migrant members of the rural households. Our theoretical framework is based on the New Economics of Labor Migration (NELM) (Stark and Bloom 1985, Taylor 1999) which helps decode the complex relationship between migration, remittances and their impact on rural households. The NELM considers migration to be a household decision used strategically to diversify income. Thus, incentives and the consequences of migration are interlinked (Taylor and Martin 2001). Remittances received by rural farming communities can help alleviate credit constraints (Rozelle et al. 1999), but increased out-migration can potentially exacerbate labour constraints, especially when production systems are not mechanized. We use the NELM theoretical framework to capture how remittances potentially shape smallholder farmers' agricultural decisions.

Various empirical studies have examined the effects of remittances on agricultural productivity. There is evidence that remittances promote agricultural asset accumulation and general investments in production (Böhme 2015, Damon 2010) thereby enhancing agricultural productivity. However, other studies observe that migration can result in falling productivity (Damon 2010, Rozelle et al. 1999, Sauer et al. 2015). This is because it may be difficult to replace experienced household labour, especially when farm labour markets are missing or incomplete. Also, households may attempt to cope with the labour losses by shifting from labour-intensive commercial cash crops to subsistence food crops

(Böhme 2015). However, the negative effects of migration on productivity can be offset by the increased liquidity provided by remittances (Kapri and Ghimire 2020). In this study we investigate how remittances affect input use, livestock accumulation, production diversification, and food security outcomes.

Our study makes a distinction between public and private transfers and examines whether the source of income matters for agricultural and food security outcomes. Public support in the form of agricultural input subsidies has regained popularity among policymakers in many African countries (Holden 2018). A recent study found that the spending on input subsidy programmes in ten African countries ranges from $0.6 to $1.0 billion per year or 14% to 26% of public expenditure on agriculture (Jayne et al. 2018). Other public transfers not specifically tied to agriculture may also impact agricultural outcomes and food security. For example, income transfers to poor households may promote short-term food security (Gilligan and Hoddinott 2007). However, some researchers argue that transfers targeted towards agriculturally productive investments may prove to be more effective than general income transfers (Hoddinott et al. 2012). For instance, it could be argued that public support for investments in agriculture may have greater potential benefits than income transfers by more effectively addressing the root causes of food insecurity (ibid.). Thus, when designing social protection programmes there may be trade-offs between those that address short-term food security needs and longer-term sustainable food security improvements.

3. Data and summary statistics

The data used come from the 2017 Poverty, Income, Consumption and Expenditure Survey (PICES), including the pre- and post-harvest Agricultural Productivity Module (APM). The unit of observation is the household and we restrict the analysis to the sample of households located in rural areas and that feature in both PICES and APM datasets. Our agricultural outcome variables of interest are:

Crop diversity/specialisation

Three indicators are used to measure crop diversity: crop count; Simpson index (SI); Entropy index (EI). Crop count is simply a count of the number of crops that were grown by the household. The SI is computed as , $1 - \sum P_i^2$, where $P_i = \frac{A_i}{\sum A_i}$ is the proportion of the the activity in acreage. If SI is near zero it indicates that the zone or region is near to specialisation in the growing of a particular crop, and if it is close to one, then the zone has full crop diversity. The EI is a direct measure of diversification having a logarithmic character and is given by:, $\sum_{i=1}^{N} P_i * \log(\frac{1}{P_i})$, where P_i represents the acreage proportion of the th crop in total cropped area. The EI increases with diversification. It approaches zero when the farm is specialised and equals one (perfect specialisation) and takes a maximum value when there is perfect diversification.

Input use in agriculture

Five dummy variables are used to capture input use. The inputs captured are organic fertilizer, inorganic fertilizer, herbicide, pesticide, and improved/hybrid seed use. These assume a value of 1 if the input was used, and 0 otherwise.

Value of livestock owned

This dependent variable represents the self-reported value of livestock owned by the household in US dollars.

Our two food security outcome variables are:

Dietary Diversity Score

The dietary diversity score of the household is created using FAO (2010) guidelines and ranges from 0 to 12. It is a sum of scores for the consumption of 12 categories of food that constitute the food pyramid. Table 1 lists the 12 food categories and the proportion of households who report having consumed any of the food from each category in the seven days prior to the survey. A score of one is assigned if a household has consumed food from a certain food group, and zero otherwise. The dietary diversity score is computed by adding up the scores across all the food categories. Thus, a household which only consumed staple starch and vegetables over the seven-day period is assigned a score of 2 out of 12. Figure 1 provides a histogram for the dietary diversity score.

Table 1: Proportion of Households Consuming Food Group in Past Seven Days

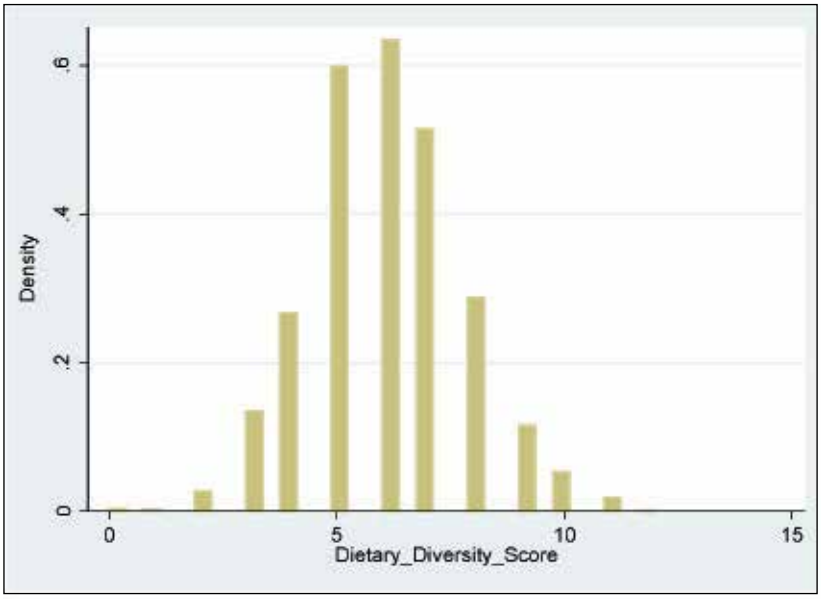
Food group	**Proportion**
Staple starch	99%
Tea and salt	98%
Fats	87%
Vegetables	84%
Sugar	73%
Beans and nuts	37%
Meat	30%
Fruit	24%
Milk	20%
Fish	17%
Eggs	11%
Potatoes and starch	11%

*Notes to the table:*The values in the table show the proportion of households who report to have consumed any of the food from the group in the seven days prior to the survey.

Share of the budget spent on food

The second measure of food security is constructed as the share of total annual expenditure allocated to food. From an Engel curve perspective, because food is an essential commodity, as total expenditure increases (that is, as the household becomes better off) the share of the budget allocated to food is expected to decline. Households with relatively low food budget shares are expected to be more food secure as it is relatively easy for them to respond to rising food prices by reducing the consumption of non-food items. On the other hand, households with higher food budget shares are regarded as less food secure.

Figure 1: Dietary Diversity Score Histogram



The main explanatory variables of interest to the study are:

International remittance receipt

This variable assumes the value of one if the household received any international cash remittances.

Domestic remittance receipt

This variable assumes the value of one if the household received any domestic cash remittances.

Food-related public transfer receipt

This variable captures the receipt of any food-related public transfers by the household. Specifically, whether the household received transfers under any of the following programmes: food mitigation programme, food for work public works programme, other

social welfare food benefits (e.g., disaster relief).

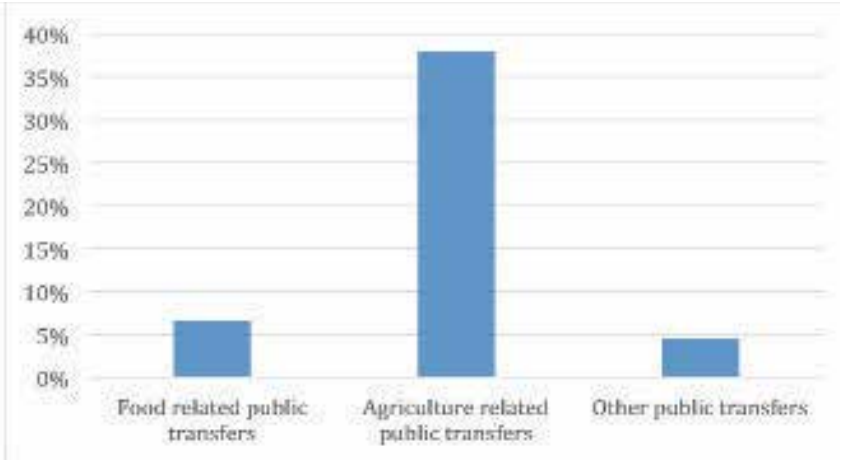
Agriculture-related public transfer receipt

This variable is indicative of the household receiving any agriculture-related public transfers such as smallholder farm input support, free seed from the government, and the receipt of any agriculture input as part of government input support programmes such as presidential input support or vulnerable input support.

Other public transfer receipt

This variable captures the receipt of any other public transfers by the household. Specifically, primary or secondary basic education assistance, harmonised social care transfer, general public assistance, medical transfer order, pauper burial, support to children in difficult circumstances, maintenance of disabled persons, maintenance of older persons, community recovery and rehabilitation programme, street children, public works programme (cash for work), health cash and in-kind social welfare benefit, education in cash and in-kind social welfare benefit, public early retirement package, public pension benefits, social security benefits, and other public transfers.

Figure 2: Proportion of households in the sample receiving specific types of public transfer



Agriculture-related public transfers have the highest proportion of recipient households with 39.7% of households in receipt of such support. The sample shows 6.2% of households are in receipt of food-related public transfers, and 4.3% in receipt of other types of public transfer.

Table 2 presents summary statistics of the agricultural outcome and food security measures, and select explanatory variables for the full sample and for households receiving remittances and public transfers, and those not in receipt.

Table 2: Summary statis s

	Full sample		I		II		III		IV	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Crop Count	3.69	2.06	3.27	2.00	3.78	2.06	3.82	2.09	3.58	2.03
Simpson Index	0.48	0.28	0.42	0.30	0.49	0.28	0.50	0.28	0.47	0.28
Entropy Index	0.76	0.48	0.63	0.48	0.79	0.48	0.80	0.49	0.73	0.47
Organic Fertilizer Use	0.50	0.50	0.48	0.50	0.51	0.50	0.49	0.50	0.51	0.50
Inorganic Fertilizer Use	0.63	0.48	0.62	0.49	0.63	0.48	0.65	0.48	0.61	0.49
Herbicide Use	0.07	0.25	0.09	0.29	0.06	0.24	0.07	0.25	0.07	0.25
Pesticide Use	0.02	0.14	0.02	0.15	0.02	0.13	0.02	0.14	0.02	0.14
Improved/Hybrid Seed	0.81	0.39	0.81	0.40	0.82	0.39	0.88	0.33	0.76	0.43
Value of Livestock	740.83	792.44	790.18	842.49	730.46	781.39	790.45	811.19	696.99	773.25
Total foods	6.01	1.70	6.06	1.64	6.00	1.71	5.95	1.63	6.06	1.77
Food share	49.56	16.02	47.45	15.78	50.00	16.04	50.04	16.23	49.13	15.83
=1 if received domestic remittances	0.15	0.36	0.87	0.34			0.15	0.36	0.15	0.36
=1 if received int'l remittances	0.03	0.16	0.16	0.37			0.03	0.16	0.03	0.17
=1 if received food public transfers	0.10	0.30	0.09	0.28	0.11	0.31	0.22	0.41	0.00	0.00
=1 if received agriculture public tran	0.38	0.48	0.35	0.48	0.38	0.49	0.80	0.40		
=1 if received other public transfers	0.06	0.24	0.11	0.31	0.05	0.22	0.13	0.33		
Total cropped area (acres)	11.04	95.15	18.74	179.25	9.42	64.84	11.53	82.55	10.60	105.07
Total consumption expenditure	221.72	153.43	256.79	199.32	214.35	140.88	224.30	158.97	219.44	148.41
Household size	4.98	2.16	5.10	2.29	4.95	2.14	5.09	2.21	4.87	2.12
=1 if head is aged below 30	0.09	0.28	0.08	0.27	0.09	0.29	0.05	0.21	0.13	0.33
= 1 if head aged 30 to 44	0.33	0.47	0.27	0.44	0.34	0.47	0.28	0.45	0.38	0.48
= 1 if head aged 45 to 59	0.26	0.44	0.24	0.43	0.26	0.44	0.27	0.45	0.24	0.43
= 1 if head aged 60plus	0.33	0.47	0.41	0.49	0.31	0.46	0.40	0.49	0.26	0.44
=1 if head male	0.64	0.48	0.58	0.49	0.65	0.48	0.61	0.49	0.67	0.47
= 1 if head no education	0.01	0.09	0.01	0.08	0.01	0.09	0.01	0.08	0.01	0.10
= 1 if head has primary education	0.47	0.50	0.51	0.50	0.46	0.50	0.51	0.50	0.44	0.50
= 1 if head has secondary education	0.40	0.49	0.35	0.48	0.40	0.49	0.35	0.48	0.43	0.50
= 1 if head has tertiary education	0.03	0.17	0.03	0.18	0.03	0.16	0.02	0.13	0.04	0.19
Manicaland	0.14	0.34	0.11	0.31	0.14	0.35	0.12	0.32	0.15	0.36
Mashonaland Central	0.12	0.33	0.03	0.18	0.14	0.35	0.12	0.32	0.12	0.33
Mashonaland East	0.13	0.34	0.08	0.27	0.15	0.35	0.10	0.30	0.17	0.37
Mashonaland West	0.13	0.34	0.18	0.39	0.12	0.33	0.14	0.35	0.12	0.33

Mashonaland North	0.11	0.31	0.22	0.42	0.09	0.28	0.12	0.32	0.10	0.31
Mashonaland South	0.12	0.32	0.05	0.23	0.13	0.34	0.15	0.35	0.09	0.29
Midlands	0.11	0.31	0.18	0.38	0.10	0.29	0.11	0.32	0.11	0.31
Masvingo	0.14	0.35	0.14	0.35	0.14	0.35	0.14	0.35	0.14	0.35
=1 if SSCFA	0.04	0.20	0.09	0.28	0.03	0.18	0.04	0.19	0.05	0.22
=1 if ORS	0.28	0.45	0.26	0.44	0.28	0.45	0.26	0.44	0.29	0.45
=1 if Communal Land	0.50	0.50	0.40	0.49	0.52	0.50	0.53	0.50	0.47	0.50
=1 if A1 land	0.18	0.39	0.25	0.44	0.17	0.37	0.18	0.38	0.19	0.39
N	1,923		334		1,589		902		1,021	

Table 3: OLS Regression Estimates

VARIABLES	Crop Count	Simpson Index	Entropy Index	Organic Fertil zer Use	Inorganic Fertil zer Use	Herbicide Use	Pes cide Use	Improved/ Hybrid Seed	Value of Livestock
=1 if received domestic remittances	-0.301**	-0.0333*	-0.116***	-0.0227	0.0553**	0.0355**	-0.00646	-0.000771	-84.07*
	(0.121)	(0.0190)	(0.0305)	(0.0312)	(0.0261)	(0.0172)	(0.00949)	(0.0246)	(49.69)
=1 if received int'l remittances	0.212	0.0753**	0.0833	0.0849	-0.00969	-0.00789	0.0175	0.00323	102.1
	(0.246)	(0.0372)	(0.0654)	(0.0706)	(0.0525)	(0.0260)	(0.0258)	(0.0615)	(117.9)
=1 if received food public trans	0.152	0.0411**	0.0421	-0.00671	-0.100***	-0.0110	-0.00647	-0.0887***	-121.6**
	(0.136)	(0.0196)	(0.0343)	(0.0365)	(0.0334)	(0.0153)	(0.00816)	(0.0314)	(55.00)
=1 if received agricultural public transfer	0.286***	0.0227*	0.0621***	-0.0206	0.148***	0.00850	0.00891	0.190***	24.89
	(0.0892)	(0.0124)	(0.0219)	(0.0228)	(0.0201)	(0.0117)	(0.00692)	(0.0159)	(35.47)
=1 if received other public transfer	-0.0211	-0.00624	-0.0158	-0.0152	0.0309	-0.00951	-0.000667	0.0219	145.3*
	(0.169)	(0.0255)	(0.0462)	(0.0470)	(0.0402)	(0.0186)	(0.0125)	(0.0359)	(86.75)
Total cropped area (acres)	0.000622**	-0.00019***	-0.0003***	0.000150***	5.24e-05	-1.32e-05	-2.59e-07	9.8e-05***	0.376***
	(0.000262)	(6.95e-05)	(0.000108)	(5.49e-05)	(9.61e-05)	(9.63e-06)	(4.52e-06)	(3.69e-05)	(0.0815)
Total consumption expenditure	0.000556*	1.32e-05	8.05e-05	0.000167**	0.000139**	7.20e-05	4.94e-05	7.71e-05	0.831***
	(0.000305)	(4.05e-05)	(6.91e-05)	(7.50e-05)	(6.21e-05)	(4.46e-05)	(3.32e-05)	(5.22e-05)	(0.146)
Household size	0.0507**	0.00505*	0.0127**	0.0111**	0.00150	-0.000896	-0.00203	0.00185	9.608
	(0.0211)	(0.00297)	(0.00525)	(0.00528)	(0.00453)	(0.00285)	(0.00174)	(0.00388)	(8.597)
=1 if head is aged below 30	-0.916***	-0.0741***	-0.152***	-0.250***	-0.122***	0.000619	0.0270	-0.0326	-485***
	(0.156)	(0.0242)	(0.0402)	(0.0434)	(0.0380)	(0.0246)	(0.0166)	(0.0356)	(67.98)
= 1 if head aged 30 to 44	-0.482***	-0.0516***	-0.104***	-0.159***	-0.0527**	-0.00870	0.00200	-0.0819***	-448***
	(0.117)	(0.0166)	(0.0287)	(0.0296)	(0.0263)	(0.0141)	(0.00711)	(0.0237)	(45.72)

= 1 if head aged 45 to 59	-0.151	-0.0254	-0.0436	-0.0737**	-0.0134	0.00397	0.0116	-0.0460**	-268***
	(0.116)	(0.0163)	(0.0281)	(0.0295)	(0.0259)	(0.0151)	(0.00878)	(0.0224)	(50.47)
= 1 if head male	0.293***	0.00881	0.0521**	0.0892***	0.0491**	0.0254**	0.0110**	0.0588***	136.3***
	(0.0925)	(0.0135)	(0.0232)	(0.0239)	(0.0207)	(0.0103)	(0.00469)	(0.0194)	(37.90)
= 1 if head no formal education	-0.304	-0.0411	-0.0237	-0.218**	0.0330	-0.0461*	-0.0109	-0.00826	-230.2
	(0.389)	(0.0715)	(0.114)	(0.111)	(0.126)	(0.0270)	(0.00953)	(0.0868)	(188.7)
= 1 if head secondary education	-0.0134	0.0274**	0.0206	0.0529**	0.0904***	0.00218	-0.00418	0.0606***	2.311
	(0.0970)	(0.0139)	(0.0239)	(0.0251)	(0.0218)	(0.0127)	(0.00719)	(0.0198)	(39.59)
= 1 if head tertiary education	-0.854***	-0.107**	-0.185***	-0.0251	0.185***	0.0486	0.0456	0.107**	-98.97
	(0.244)	(0.0416)	(0.0623)	(0.0754)	(0.0572)	(0.0425)	(0.0328)	(0.0461)	(113.9)
= 1 if small scale commercial farming land	-0.385*	-0.0482	-0.115**	0.138**	0.151***	0.0464	0.0434	0.0517	168.6
	(0.215)	(0.0303)	(0.0522)	(0.0609)	(0.0410)	(0.0430)	(0.0336)	(0.0361)	(111.9)
= 1 if old resettlement scheme	-0.478***	-0.0281	-0.0850***	0.110***	0.0398	-0.0505**	-0.0310***	-0.0121	87.82
	(0.133)	(0.0186)	(0.0316)	(0.0335)	(0.0292)	(0.0203)	(0.0120)	(0.0244)	(57.25)
= 1 if communal land	-0.355***	-0.0122	-0.00809	0.0933***	-0.0354	-0.0787***	-0.0305***	-0.0976***	-198***
	(0.121)	(0.0167)	(0.0290)	(0.0307)	(0.0270)	(0.0177)	(0.0104)	(0.0242)	(49.96)
Province level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,917	1,917	1,917	1,923	1,923	1,923	1,923	1,923	1,923
R-squared	0.238	0.166	0.162	0.146	0.311	0.155	0.084	0.133	0.171

4. METHODOLOGY

The research undertakes descriptive analyses using Ordinary Least Square (OLS) regression and Linear Probability Model (LPM) analysis to estimate factors that determine the agricultural outcomes of rural households using the 2017 Poverty, Income, Consumption, Expenditure Survey, including the pre- and post-harvest Agriculture Productivity Module of the survey. Given that the majority of dependent variables are binary in nature, the LPM model is mostly employed.

The following relationship is estimated:

$$Y_i = \alpha + \gamma_j DR_i + \hat{\partial}_j IR_i + \lambda_j FT_i + \tau_j AT_i + \eta_j OT_i + z_i'\gamma_j + \varepsilon \quad (1)$$

where is the dependent variable and captures the agricultural outcome. The three main agricultural outcome variables as discussed in section III above are: Input use in agriculture; Crop diversity/specialisation, and Value of livestock owned. In the food security model, captures two food security variables: the dietary diversity score and the share of the total household budget allocated towards food.

The explanatory variables in equation (1) are which is a dummy variable capturing the receipt of domestic migrant remittances by the household, which is a dummy variable capturing the receipt of international migrant remittances by the household, capturing the receipt of food-related public transfers by the household, capturing the receipt of agriculture-related public transfers by the household, capturing the receipt of other public transfers by the household, a vector of household and other characteristics, and an error term. We note that the aforementioned variables are likely to be endogenous. However, accounting for the potential endogeneity of transfers is reserved as an agenda for future research. Therefore, the results obtained are interpreted as associations, rather than causal.

5. EMPIRICAL FINDINGS

In this section we discuss the empirical results that are obtained when the various specifications of equation (1) are estimated in determining the relationship between private transfers, public transfers and the agricultural and food security outcomes of rural households.

1.1 The relationship between remittances, public transfers and agricultural outcomes

Table 3 presents results from OLS models with the following agricultural outcomes: crop diversification, input use and livestock value. Some observations stemming from the findings as follows:

1.2 Households receiving agriculture-related public transfers are more likely to diversify crop production.

Table 3 reveals a positive and statistically significant association between the receipt of agriculture-related public transfers and crop diversification.

1.3 Households receiving agriculture-related public transfers are more likely to use modern agricultural inputs.

The receipt of public transfers is associated with a 14.8% increase in inorganic fertilizer use and a 19% increase in the use of improved/hybrid seed, on average and *ceteris paribus.*

The positive relationship between agriculture-related public transfers and crop diversification as well as inorganic fertilizer and improved/hybrid seed use may stem from the nature of transfers provided. Specifically, free seed and inorganic fertilizer are amongst the various types of input provided under the presidential input support and the vulnerable input support programmes.

1.4 Households receiving food-related public transfers are less likely to use modern agriculture inputs.

Table 3 reveals negative and statistically significant associations between the receipt of public transfers and inorganic and improved/hybrid seed use.

1.5 Households receiving domestic remittances are less likely to diversify their crops

Table 3 shows negative and statistically significant associations between the receipt of domestic remittances and crop diversification for all the three indicators of crop diversification used in the study.

1.6 Households receiving domestic remittances are more likely to use modern agricultural inputs

The receipt of domestic remittances is associated with a 5.5% and 3.6% increase in the use of inorganic fertilizer and herbicides, respectively.

1.7 International remittances do not appear to have any significant correlation with agricultural outcomes.

There are largely no statistically significant effects for the international remittances coefficients in Table 3.(p.20)

1.8 The gender of the household head has a significant relationship with agricultural outcomes

Table 3 reveals that the gender of the household head has a positive and statistically significant relationship with most of the agricultural outcomes employed in the current study. In particular, male-headed households are more likely to diversify their crop production, relative to female-headed households; they are also more likely to use modern

inputs. Specifically, there is a 0.3% increase in crop count and a 0.05: increase in the entropy index for male-headed households. The probability of using organic and inorganic fertilizer is 8.9% and 4.9% higher for households with male heads while herbicide and pesticide use is 2.5% and 1.1% higher, respectively. The value of livestock owned is USD136 higher in male-headed households than in female-headed ones on average, and *ceteris paribus*. This finding is unsurprising for the Zimbabwe context as males are customarily more likely to own livestock.

Other findings in Table 3 show that households on small scale commercial farming, old resettlement scheme, and communal land are all less likely to diversify their crop production and more likely to use organic fertilizer relative to households on A1 land. Small scale commercial farming households are more likely to use inorganic fertilizer relative to A1 households. Old resettlement scheme and communal households are less likely to use herbicides and pesticides and improved seed. Households on communal land are less likely to use herbicides, pesticides, and improved/hybrid seed, relative to A1 households. The value of livestock owned by households on communal land is USD198 less than that of households on A1 land on average, and *ceteris paribus.* Thus, there seem to be heterogeneities in the relationship between remittances, public transfers, and agricultural outcomes. To explore this further, we run separate regression estimates by land type.

1.9 The relationship between public transfers, remittances, and agricultural outcomes varies by land ownership

Table 4 provides separate estimates for regressions by land type. We see that the receipt of agriculture-related public transfers is associated with an increase in crop diversification and an increase in inorganic fertilizer and improved/hybrid fertilizer use for households on communal land. Domestic remittances are associated with a decrease in crop diversification and an increase in inorganic fertilizer use for communal households. International remittances seem to increase crop diversification for communal households. No significant effects are found for households on A1 land for either domestic or international remittances. Agriculture-related public transfers are shown to have a positive correlation with inorganic fertilizer and pesticide use. For households on old resettlement scheme land, domestic remittances seem to have a negative correlation with crop diversification while the receipt of agriculture-related public transfers has a positive association with inorganic fertilizer and improved/hybrid seed use. For small scale commercial farming households, the receipt of remittances or public transfers does not appear to have a notable correlation with agricultural outcomes.

1.10 The relationship between public transfers and agricultural outcomes varies by agro-ecological zone

Next, it could be argued the use of remittances for agricultural inputs may be more likely in more dynamic agricultural settings where land quality and rainfall are generally sufficient to induce an input-based response. For example, households located in isolated and poor-quality

Table 4: OLS Regression Estimates by Land Type

Communal Land									
VARIABLES	**Crop Count**	**Simpson Index**	**Entropy Index**	**Organic Fertilizer Use**	**Inorganic Fertilizer Use**	**Herbicide Use**	**Pesticide Use**	**Improved/ Hybrid Seed**	**Value of Livestock**
=1 if received domestic remittances	-0.450**	-0.0581**	-0.17***	-0.096**	0.0989**	0.0137	-0.00387	-0.0257	-108.1*
	(0.190)	(0.0295)	(0.0488)	(0.0487)	(0.0426)	(0.0164)	(0.00248)	(0.0415)	(58.57)
=1 if received international remittances	0.747**	0.0686	0.157*	0.0941	0.0404	0.00786	-0.00461	0.101	216.9
	(0.380)	(0.0475)	(0.0891)	(0.101)	(0.0804)	(0.00629)	(0.00621)	(0.0824)	(161.7)
=1 if received food public transfers	0.104	0.0220	0.0338	-0.0275	-0.084**	-4.83e-05	-0.00661	-0.0910**	-68.61
	(0.169)	(0.0234)	(0.0425)	(0.0448)	(0.0423)	(0.0142)	(0.00450)	(0.0420)	(63.86)
=1 if received agriculture public transfers	0.490***	0.0696***	0.132***	-0.0216	0.178***	0.0152	0.000865	0.252***	8.993
	(0.127)	(0.0173)	(0.0312)	(0.0325)	(0.0307)	(0.0107)	(0.00337)	(0.0247)	(44.98)
=1 if received other public transfers	0.172	0.00900	0.00516	0.0492	0.0823	0.0203	-0.00330	0.0628	5.528
	(0.240)	(0.0313)	(0.0623)	(0.0665)	(0.0575)	(0.0231)	(0.00229)	(0.0480)	(89.27)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	952	952	952	957	957	957	957	957	957
R-squared	0.250	0.156	0.184	0.155	0.291	0.108	0.028	0.160	0.143

A1 Land									
VARIABLES	**Crop Count**	**Simpson Index**	**Entropy Index**	**Organic Fertilizer Use**	**Inorganic Fertilizer Use**	**Herbicide Use**	**Pesticide Use**	**Improved Seed**	**Value of Livestock**
=1 if received domestic remittances	0.335	-0.00752	0.0107	-0.0321	-0.0537	0.0378	-0.0154	-0.0156	-133.9
	(0.276)	(0.0370)	(0.0658)	(0.0701)	(0.0547)	(0.0508)	(0.0352)	(0.0542)	(124.4)
=1 if received international remittances	-0.174	0.0389	0.0786	0.136	-0.0831	-0.0775	0.0540	-0.144	47.30
	(0.393)	(0.0757)	(0.135)	(0.135)	(0.0572)	(0.102)	(0.0968)	(0.130)	(269.8)
=1 if received food public transfers	-0.353	0.0182	-0.0580	0.146	-0.103	-0.106*	-0.0848***	-0.162*	-457.8***
	(0.299)	(0.0514)	(0.0800)	(0.0912)	(0.0688)	(0.0625)	(0.0257)	(0.0845)	(124.5)
=1 if received agriculture public transfers	0.0966	-0.00998	0.0172	-0.0443	0.0983**	-0.0229	0.0122	0.143***	141.3
	(0.191)	(0.0271)	(0.0491)	(0.0582)	(0.0417)	(0.0420)	(0.0328)	(0.0375)	(106.0)
=1 if received other public transfers	-0.0325	0.0184	0.00874	-0.114	-0.0716	-0.0250	-0.0227	-0.0154	278.6

	(0.369)	(0.0526)	(0.101)	(0.0979)	(0.0779)	(0.0462)	(0.0218)	(0.0877)	(224.3)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	353	353	353	353	353	353	353	353	353
R-squared	0.404	0.359	0.303	0.156	0.510	0.223	0.116	0.116	0.209

Old Resettlement Scheme

VARIABLES	Crop Count	Simpson Index	Entropy Index	Organic Fertilizer Use	Inorganic Fertilizer Use	Herbicide Use	Pesticide Use	Improved Seed	Value of Livestock
=1 if received domestic remittances	-0.431*	-0.0160	-0.134**	0.0166	0.0553	0.0292	-0.00647	0.0189	23.22
	(0.228)	(0.0406)	(0.0565)	(0.0598)	(0.0502)	(0.0313)	(0.00405)	(0.0458)	(112.2)
=1 if received international remittances	0.0481	0.00593	0.0373	-0.0714	-0.110	-0.0300	0.00846	-0.0209	-70.89
	(0.511)	(0.110)	(0.151)	(0.158)	(0.184)	(0.0187)	(0.00815)	(0.112)	(197.4)
=1 if received food public transfers	0.820**	0.110**	0.165**	-0.112	-0.171*	-0.0730***	-0.0127	-0.0120	-87.34
	(0.338)	(0.0533)	(0.0820)	(0.0935)	(0.100)	(0.0269)	(0.0133)	(0.0456)	(175.5)
=1 if received agriculture public transfers	0.0876	-0.0240	0.0130	-0.0114	0.151***	0.0208	0.00623	0.131***	-25.63
	(0.170)	(0.0251)	(0.0413)	(0.0431)	(0.0354)	(0.0237)	(0.0101)	(0.0277)	(70.42)
=1 if received other public transfers	-0.402	-0.0271	-0.0566	-0.110	0.000102	0.00878	-0.00246	-0.0474	291.3
	(0.381)	(0.0807)	(0.114)	(0.104)	(0.0922)	(0.0409)	(0.00391)	(0.0849)	(219.9)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	528	528	528	529	529	529	529	529	529
R-squared	0.302	0.178	0.193	0.191	0.326	0.070	0.036	0.159	0.197

Small Scale Commercial Farming Area

VARIABLES	Crop Count	Simpson Index	Entropy Index	Organic Fertilizer Use	Inorganic Fertilizer Use	Herbicide Use	Pesticide Use	Improved Seed	Value of Livestock

=1 if received domestic remittances	-0.261	0.0904	0.0321	0.0529	0.0436	0.0153	-0.100	0.0781	-161.4
	(0.485)	(0.0552)	(0.102)	(0.188)	(0.0887)	(0.0942)	(0.0852)	(0.0650)	(267.3)
=1 if received international remittances	-0.375	0.296***	-0.260*	0.581***	0.176	-0.0763	0.0187	-0.226	-824.7
	(0.983)	(0.0789)	(0.155)	(0.172)	(0.175)	(0.107)	(0.0746)	(0.276)	(498.7)
=1 if received food public transfers	1.173	0.255***	0.280*	0.106	-0.182*	-0.0162	0.0385	-0.0330	-95.84
	(0.753)	(0.0836)	(0.162)	(0.268)	(0.0997)	(0.157)	(0.138)	(0.0877)	(377.7)
=1 if received agriculture public transfers	-0.557	-0.111**	-0.203**	-0.0472	0.123*	-0.0313	0.101	0.0630	165.6
	(0.435)	(0.0518)	(0.0885)	(0.139)	(0.0701)	(0.0967)	(0.0688)	(0.0524)	(266.6)
=1 if received other public transfers	-1.130*	-0.00420	-0.0549	-0.263	-0.0830	-0.166	0.574**	0.00248	219.0
	(0.568)	(0.0512)	(0.0971)	(0.334)	(0.234)	(0.144)	(0.265)	(0.108)	(519.3)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	84	84	84	84	84	84	84	84	84
R-squared	0.470	0.673	0.568	0.183	0.571	0.507	0.448	0.455	0.400

Table 5: OLS Regressions by Natural Region

Natural Region 1									
VARIABLES	**Crop Count**	**Simpson Index**	**Entropy Index**	**Organic Fertil zer Use**	**Inorganic Fertil zer Use**	**Herbicide Use**	**Pes cide Use**	**Improved/ Hybrid Seed**	**Value of Livestock**
=1 if receive remittances	-1.047	-0.0502	-0.272*	0.0330	-0.212	0.0504	Ψ	-0.282	-30.62
	(0.688)	(0.174)	(0.159)	(0.279)	(0.215)	(0.0673)		(0.227)	(297.1)
=1 if receive international remittances	-0.154	0.353	0.406	0.108	0.402**	-0.0484	Ψ	0.277	281.6
	(0.839)	(0.226)	(0.347)	(0.393)	(0.169)	(0.0622)		(0.207)	(348.5)
=1 if receive transfers	-0.0279	-0.0705	-0.0242	-0.449	0.0972	0.0910	Ψ	-0.290	-343.9
	(0.783)	(0.168)	(0.261)	(0.290)	(0.195)	(0.0707)		(0.182)	(345.7)
=1 if receive public transfers	-0.232	-0.0522	-0.0878	-0.132	0.358*	0.112	Ψ	0.281*	196.0
	(0.560)	(0.121)	(0.171)	(0.208)	(0.194)	(0.0934)		(0.155)	(322.9)
=1 if receive public transfers	0.158	-0.116	-0.139	0.0243	-0.0794	-0.142	Ψ	-0.497*	-824.3**
	(0.845)	(0.228)	(0.334)	(0.451)	(0.241)	(0.112)		(0.245)	(365.9)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
Province level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
Observations	54	54	54	54	54	54		54	54
R-squared	0.256	0.357	0.328	0.401	0.549	0.261		0.595	0.525

Natural Region 2									
VARIABLES	**Crop Count**	**Simpson Index**	**Entropy Index**	**Organic Fertil zer Use**	**Inorganic Fertil zer Use**	**Herbicide Use**	**Pes cide Use**	**Improved/ Hybrid Seed**	**Value of Livestock**
=1 if receive remittances	-0.0228	-0.0292	-0.0771	0.00684	0.00932	0.132**	-0.00335	0.00273	133.6
	(0.256)	(0.0387)	(0.0588)	(0.0680)	(0.0331)	(0.0599)	(0.0380)	(0.0552)	(107.5)
=1 if receive international remittances	-0.0995	0.0775	-0.0267	-0.161	-0.0612	-0.104	0.0813	-0.165	-261.1
	(0.435)	(0.0720)	(0.116)	(0.122)	(0.0972)	(0.118)	(0.127)	(0.154)	(233.2)
=1 if receive transfers	-0.290	0.0375	-0.0749	0.114	-0.0893	-0.104	-0.0344	-0.0817	-135.4
	(0.300)	(0.0564)	(0.0815)	(0.0907)	(0.0607)	(0.0750)	(0.0420)	(0.0783)	(140.2)
=1 if receive public transfers	0.0713	0.00193	0.0280	0.0433	0.0567**	0.0333	0.0222	0.138***	38.38
	(0.176)	(0.0248)	(0.0408)	(0.0473)	(0.0238)	(0.0378)	(0.0244)	(0.0328)	(75.53)
=1 if receive public transfers	-0.731*	-0.0447	-0.112	-0.120	0.0883***	0.00527	-0.0105	-0.0102	103.9
	(0.374)	(0.0702)	(0.0831)	(0.136)	(0.0308)	(0.103)	(0.0566)	(0.116)	(211.8)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province level fixe effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	480	480	480	480	480	480	480	480	480
R-squared	0.152	0.175	0.136	0.218	0.077	0.197	0.134	0.102	0.142

Natural Region 3									
VARIABLES	**Crop Count**	**Simpson Index**	**Entropy Index**	**Organic Fertilizer Use**	**Inorganic Fertilizer Use**	**Herbicide Use**	**Pesticide Use**	**Improved/ Hybrid Seed**	**Value of Livestock**
=1 if received domestic remittances	-0.123	0.0151	-0.0475	-0.0311	0.0546	-0.00152	-0.0149*	-0.0317	-113.4
	(0.258)	(0.0384)	(0.0587)	(0.0662)	(0.0504)	(0.0246)	(0.00849)	(0.0515)	(94.61)
=1 if received international remittances	-0.393	0.0818	-0.0474	-0.0940	-0.328*	-0.143	-0.0216	0.146*	-643.1***
	(0.778)	(0.200)	(0.216)	(0.223)	(0.191)	(0.132)	(0.0294)	(0.0836)	(194.6)
=1 if received food public transfers	0.539	-0.0307	0.0950	0.452***	-0.135	-0.228***	-0.0117	-0.0713	72.76
	(0.751)	(0.0972)	(0.168)	(0.0696)	(0.182)	(0.0876)	(0.0138)	(0.139)	(226.4)
=1 if received agriculture public transfers	0.382**	0.0252	0.0818*	-0.0320	0.132***	0.0106	0.0177	0.108***	93.06
	(0.181)	(0.0247)	(0.0422)	(0.0460)	(0.0345)	(0.0234)	(0.0134)	(0.0328)	(70.91)
=1 if received other public transfers	0.0273	-0.0118	-0.126	0.0458	0.0120	-0.0372	-0.0194*	0.0156	302.7
	(0.418)	(0.0675)	(0.0958)	(0.122)	(0.100)	(0.0252)	(0.0117)	(0.0763)	(250.9)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	441	441	441	441	441	441	441	441	441
R-squared	0.425	0.247	0.302	0.177	0.172	0.241	0.046	0.077	0.262

Natural Region 4									
VARIABLES	**Crop Count**	**Simpson Index**	**Entropy Index**	**Organic Fertilizer Use**	**Inorganic Fertilizer Use**	**Herbicide Use**	**Pesticide Use**	**Improved/ Hybrid Seed**	**Value of Livestock**
=1 if received domestic remittances	-0.288	-0.0251	-0.111**	-0.0561	0.0306	-0.00187	-0.0137*	-0.0107	-155.1**
	(0.181)	(0.0287)	(0.0503)	(0.0466)	(0.0452)	(0.0124)	(0.00738)	(0.0366)	(78.20)
=1 if received international remittances	0.589*	0.0860	0.144	0.236***	-0.0547	0.00306	-0.00657	0.0112	323.5**
	(0.338)	(0.0537)	(0.0898)	(0.0891)	(0.0722)	(0.00617)	(0.00648)	(0.0812)	(164.3)
=1 if received food public transfers	0.281	0.0442	0.0695	-0.120**	-0.0682	-0.00363	-0.00599	-0.0533	-84.58
	(0.185)	(0.0269)	(0.0473)	(0.0467)	(0.0496)	(0.0145)	(0.00505)	(0.0404)	(80.36)
=1 if received agriculture public transfers	0.0201	0.00931	-0.00709	-0.0213	0.247***	0.0201*	0.00794	0.238***	-33.66
	(0.147)	(0.0221)	(0.0384)	(0.0379)	(0.0390)	(0.0118)	(0.00731)	(0.0269)	(62.78)
=1 if received other public transfers	0.00739	0.00374	-0.00154	-0.0106	0.0368	0.00230	0.0143	0.0709	115.3
	(0.234)	(0.0351)	(0.0675)	(0.0635)	(0.0581)	(0.0169)	(0.0159)	(0.0435)	(123.0)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	694	694	694	696	696	696	696	696	696
R-squared	0.262	0.206	0.204	0.233	0.224	0.076	0.055	0.184	0.202

Natural Region 5									
VARIABLES	**Crop Count**	**Simpson Index**	**Entropy Index**	**Organic Fertilizer Use**	**Inorganic Fertilizer Use**	**Herbicide Use**	**Pesticide Use**	**Improved/ Hybrid Seed**	**Value of Livestock**
=1 if received domestic remittances	0.675	-0.0356	0.0100	-0.254	0.175	Ψ	Ψ	-0.0760	-29.88
	(0.573)	(0.0662)	(0.167)	(0.156)	(0.144)			(0.134)	(323.9)
=1 if received international remittances	0.773	-0.0145	0.109	-0.0926	0.132	Ψ	Ψ	0.0745	17.63
	(0.912)	(0.131)	(0.287)	(0.225)	(0.182)			(0.138)	(243.6)
=1 if received food public transfers	0.0860	0.0262	0.0391	0.122	-0.0290	Ψ	Ψ	-0.0704	-158.0
	(0.287)	(0.0392)	(0.0704)	(0.0896)	(0.0663)			(0.0819)	(114.6)
=1 if received agriculture public transfers	0.477*	0.0585*	0.156**	-0.0385	0.231***	Ψ	Ψ	0.323***	-39.99
	(0.254)	(0.0311)	(0.0628)	(0.0679)	(0.0608)			(0.0536)	(86.63)
=1 if received other public transfers	0.298	0.0215	0.115	-0.0149	-0.0116	Ψ	Ψ	0.0692	52.73
	(0.458)	(0.0497)	(0.107)	(0.106)	(0.102)			(0.0993)	(178.9)
Other control variables	Yes	Yes	Yes	Yes	Yes			Yes	Yes
Province level fixed effects	Yes	Yes	Yes	Yes	Yes			Yes	Yes
Observations	246	246	246	250	250			250	250
R-squared	0.472	0.428	0.409	0.144	0.213			0.312	0.208

areas may receive remittances as a means of survival, rather than for use towards agricultural production. We therefore explore whether there are heterogeneities in the relationship between public and private transfers by the agro-ecological zone. The five agro-ecological zones in Zimbabwe represent unique combinations of homogenous agro-climate, ecology, soil units and agricultural activities. Agricultural suitability is highest in region 1 and least in region 5. To investigate such heterogeneities, we estimate separate regressions for each of the five zones and report these in Table 5. There do not appear to be any notable correlations between remittances, public transfers and agricultural households in natural region 1. However, we note the small sample size of households in this region. In natural region 2, domestic remittances are positively associated with herbicide use. Agriculture-related transfers have a positive correlation with inorganic fertilizer and improved/hybrid seed use in regions 2, 3, 4, and 5. In addition, agriculture-related transfers also have a positive association with crop diversification in regions 3 and 5.

2. The relationship between remittances, public transfers and food security

We now investigate the relationship between public and private transfers and food security.

2.1 Food-related public transfers are received by poorer households; international remittances are received by less poor households

Table 6 shows that neither remittances nor public transfers have a statistically significant association with dietary diversity score. This is with the exception of food-related transfers which seem to have a negative, albeit small, association with dietary diversity. The receipt of food-related public transfers is shown to have a positive association with the share of the household budget allocated towards food. This suggests food-related public transfers are received by poorer households, as expected. On the other hand, international remittances have a negative association with the share of the budget allocated towards food. That is, households that are less poor are likely to receive international remittances. Again, this comports with expectations. Agriculture-related and other types of public transfers appear not to have any statistically significant association with the food security of households.

Table 6: OLS regressions

Variables	Dietary Diversity	Food Budget Share
=1 if received domestic remittances	-0.0426	-1.307
	(0.0991)	(1.001)
=1 if received international remittances	0.188	-6.381***
	(0.207)	(2.074)

VARIABLES	Dietary Diversity	Food Budget Share
	(0.207)	(2.074)
=1 if received food public transfers	-0.191*	2.063*
	(0.113)	(1.133)
=1 if received agriculture public transfers	-0.0130	0.483
	(0.0758)	(0.736)
=1 if received other public transfers	0.119	-1.297
	(0.163)	(1.531)
Total cropped area (acres)	0.000152	-0.00604***
	(0.000390)	(0.00139)
Total consumption expenditure	0.00187***	-0.0217***
	(0.000284)	(0.00283)
Household size	-0.0314*	0.986***
	(0.0184)	(0.175)
=1 if head is aged below 30	-0.546***	1.155
	(0.142)	(1.392)
= 1 if head aged 30 to 44	-0.543***	1.368
	(0.0992)	(0.977)
= 1 if head aged 45 to 59	-0.195*	0.759
	(0.101)	(0.960)
= 1 if head male	0.219***	0.0934
	(0.0796)	(0.765)
= 1 if head has no formal education	-0.563*	-2.259
	(0.317)	(3.680)
= 1 if head has secondary education	0.388***	-1.583*
	(0.0844)	(0.826)
= 1 if head has tertiary education	0.997***	-9.868***
	(0.247)	(2.299)
= 1 if small scale commercial farming land	0.289*	-7.424***
	(0.165)	(1.579)

VARIABLES	Dietary Diversity	Food Budget Share
= 1 if old resettlement scheme land	0.0541	-5.878***
	(0.114)	(1.071)
= 1 if communal land	-0.353***	-3.142***
	(0.104)	(0.993)
Province level fixed effects	Yes	Yes
Observations	1,923	1,923
R-squared	0.167	0.128

Notes to the table: (i) Standard errors are reported in parentheses. (ii) *, **, *** represent the statistical significance of the differences for the 10 per cent, 5 per cent and 1 per cent significance levels respectively. (iii) All control variables included in regressions reported in Table 3 are included in all specifications. (iv) Ten province level fixed effects are included in all the specifications.

2.2 Male-headed households have more diverse diets

The finding that male-headed households tend to have more diverse diets corroborates the finding discussed in 1.7. that male-headed households are more likely to have more diverse crop production, to employ modern agricultural inputs, and to own livestock of higher value.

2.3 The relationship between remittances, public transfers, and food security varies by land ownership

In Table 7, for households located on communal and A1 land, richer households are more likely to receive international remittances. The receipt of food-related public transfers has a negative correlation with dietary diversity for households on A1 land. Food-related public transfers are shown to be received by poorer households for households located on old resettlement scheme land.

Table 7: OLS regressions by land type

Communal Land		
VARIABLES	**Dietary Diversity**	**Food Budget Share**
=1 if received domestic remittances	0.0758	-0.0569
	(0.154)	(1.583)
=1 if received international remittances	0.272	-7.227**
	(0.289)	(2.901)

=1 if received food public transfers	-0.204	1.164
	(0.148)	(1.392)
=1 if received agriculture public transfers	0.0247	1.268
	(0.108)	(1.083)
=1 if received other public transfers	0.151	-2.639
	(0.249)	(2.247)
Other control variables	Yes	Yes
Province level fixed effects	Yes	Yes
Observations	957	957
R-squared	0.178	0.102

A1 Land

VARIABLES	**Dietary Diversity**	**Food Budget Share**
=1 if received domestic remittances	-0.159	-2.014
	(0.219)	(1.913)
=1 if received international remittances	0.283	-10.58***
	(0.425)	(3.551)
=1 if received food public transfers	-0.525**	0.380
	(0.258)	(2.576)
=1 if received agriculture public transfers	0.133	1.083
	(0.178)	(1.692)
=1 if received other public transfers	-0.137	0.772
	(0.301)	(3.265)
Other control variables	Yes	Yes
Province level fixed effects	Yes	Yes
Observations	353	353
R-squared	0.155	0.259

Old Resettlement Scheme

VARIABLES	Dietary Diversity	Food Budget Share
=1 if received domestic remittances	-0.0192	-2.439
	(0.197)	(2.042)
=1 if received international remittances	0.0462	-0.0900
	(0.488)	(6.838)
=1 if received food public transfers	-0.179	8.592**
	(0.323)	(3.428)
=1 if received agriculture public transfers	-0.152	-2.628*
	(0.157)	(1.420)
=1 if received other public transfers	0.414	-0.357
	(0.386)	(3.469)
Other control variables	Yes	Yes
Province level fixed effects	Yes	Yes
Observations	529	529
R-squared	0.181	0.099

Small Scale Commercial Farming Area

VARIABLES	Dietary Diversity	Food Budget Share
=1 if received domestic remittances	-0.362	-1.339
	(0.359)	(3.576)
=1 if received international remittances	-0.150	-3.458
	(0.520)	(4.190)
=1 if received food public transfers	0.604	1.699
	(0.572)	(4.662)
=1 if received agriculture public transfers	0.237	6.734*
	(0.340)	(3.442)

=1 if received other public transfers	0.351	-10.30
	(0.536)	(6.763)
Other control variables	Yes	Yes
Province level fixed effects	Yes	Yes
Observations	84	84
R-squared	0.428	0.546

Notes to the table: (i) Standard errors are reported in parentheses. (ii) *, **, *** represent the statistical significance of the differences for the 10 per cent, 5 per cent and 1 per cent significance levels respectively. (iii) All control variables included in regressions reported in Table 3 are included in all specifications. (iv) Ten province level fixed effects are included in all the specifications.

2.3 The relationship between remittances and food security varies by agro-ecological zone

As we did previously, we also explore whether there are heterogeneities in the association between remittances, public transfers and food security based on agro-ecological zone. In Table 8 we see a negative association between remittance receipt and food budget shares in natural regions 1, 2 and 5. We also see a positive association between food budget share and food-related public transfers on natural region 4. In region 5, the receipt of domestic remittances is shown to have a negative association with dietary diversity.

Table 8: OLS regressions by natural region type

Natural Region 1

VARIABLES	Dietary Diversity	Food Budget Share
=1 if received domestic remittances	-0.425	2.197
	(1.014)	(5.055)
=1 if received international remittances	0.213	-11.49**
	(0.549)	(4.279)
=1 if received food public transfers	-0.0435	6.909
	(0.696)	(6.705)
=1 if received agriculture public transfers	0.226	6.685
	(0.672)	(5.019)
=1 if received other public transfers	-0.593	-3.618
	(0.868)	(5.324)
Other control variables	Yes	Yes
Province level fixed effects	Yes	Yes

Observations	54	54
R-squared	0.292	0.528
Natural Region 2		
VARIABLES	**Dietary Diversity**	**Food Budget Share**
=1 if received domestic remittances	-0.0911	-2.292
	(0.203)	(2.255)
=1 if received international remittances	0.257	-10.35**
	(0.550)	(4.407)
=1 if received food public transfers	-0.191	-4.056
	(0.276)	(2.561)
=1 if received agriculture public transfers	-0.182	-1.525
	(0.174)	(1.555)
=1 if received other public transfers	-0.0121	-4.492
	(0.373)	(3.179)
Other control variables	Yes	Yes
Province level fixed effects	Yes	Yes
Observations	480	480
R-squared	0.110	0.155
Natural Region 3		
VARIABLES	**Dietary Diversity**	**Food Budget Share**
=1 if received domestic remittances	0.322	-0.825
	(0.206)	(1.992)
=1 if received international remittances	-0.123	-7.023
	(0.702)	(8.587)
=1 if received food public transfers	-0.335	6.420
	(0.646)	(5.120)
=1 if received agriculture public transfers	-0.173	-0.00398
	(0.133)	(1.393)
=1 if received other public transfers	0.111	0.703
	(0.415)	(3.675)
Other control variables	Yes	Yes
Province level fixed effects	Yes	Yes
Observations	441	441
R-squared	0.190	0.200
Natural Region 4		
VARIABLES	**Dietary Diversity**	**Food Budget Share**

=1 if received domestic remittances	-0.120	-1.192
	(0.153)	(1.538)
=1 if received international remittances	0.172	-2.946
	(0.256)	(2.915)
=1 if received food public transfers	-0.195	2.923*
	(0.156)	(1.636)
=1 if received agriculture public transfers	0.152	0.164
	(0.133)	(1.281)
=1 if received other public transfers	0.327	1.412
	(0.233)	(2.223)
Other control variables	Yes	Yes
Province level fixed effects	Yes	Yes
Observations	696	696
R-squared	0.200	0.147
Natural Region 5		
VARIABLES	**Dietary Diversity**	**Food Budget Share**
=1 if received domestic remittances	-1.107***	4.089
	(0.423)	(4.429)
=1 if received international remittances	-0.404	-11.87**
	(0.616)	(5.086)
=1 if received food public transfers	0.00442	4.435
	(0.283)	(2.757)
=1 if received agriculture public transfers	0.104	2.990
	(0.218)	(2.096)
=1 if received other public transfers	-0.550	-6.496
	(0.343)	(3.996)
Other control variables	Yes	Yes
Province level fixed effects	Yes	Yes
Observations	250	250
R-squared	0.354	0.204

Notes to the table: (i) Standard errors are reported in parentheses. (ii) *, **, *** represent the statistical significance of the differences for the 10 per cent, 5 per cent and 1 per cent significance levels respectively. (iii) All control variables included in regressions reported in Table 3 are included in all specifications. (iv) Ten province level fixed effects are included in all the specifications.

Lastly, we undertake sensitivity checks to see whether the relationships discussed above are sensitive to differences along the quantile distribution by estimating quantile regressions. The estimated effects largely comport with results obtained using OLS and LPM regressions.

6. Conclusions and policy recommendations

The findings of our research reveal that the type of public transfer received by households matters for their agricultural outcomes. Specifically, agriculture-related public transfers have a positive association with crop diversification and the use of modern agriculture inputs, particularly inorganic fertilizer and improved/hybrid seed. On the other hand, households receiving food and other types of public transfer tend to specialise rather than diversify their crop production. There are no statistically significant associations between food- and other types of public transfer and agriculture input use and other outcomes.

The evidence obtained shows international remittances appear to be largely unrelated to the agricultural and food security outcomes of rural households. This is likely a result of the small number of rural households in receipt of international remittances. On the other hand, unlike agriculture-related public transfers, domestic remittances are associated with a decrease in crop diversification. But, similar to agriculture-related public transfers, domestic remittances seem to enable households to use more modern agricultural inputs, particularly inorganic fertilizer and herbicides. This may suggest that domestic remittances and public-transfers have different roles while also being complementary. That is, domestic remittances seem to promote homogenous crop production while agriculture-related public transfers seem to promote crop diversification. Both transfers, however, seem to promote the use of modern agricultural inputs.

Other specific findings show that households headed by men are more likely to diversify crop production and to use modern agricultural inputs. The value of their livestock is also higher than that of female-headed households. This ties in with the finding that male-headed households are more food secure than female households as they have more diverse diets.

We also find evidence that food-related transfers are received by poorer households. Furthermore, we find the receipt of international remittances to be accruing to less poor households. This is possibly a result of richer households being better placed to send household members abroad.

It is notable that despite public transfers having a positive association with crop diversification, this does not seem to translate to an increase in nutritional intake as measured by dietary diversity. This is also the case for domestic and international remittances.

The findings also reveal heterogeneities in the relationship between remittances and public transfers, and agricultural outcomes and food security depending on the agro-ecological zone. The use of remittances by rural households also seems to vary by zone. Therefore, the role of remittances in contributing towards agricultural productivity and food

security varies depending on the location of recipient households.

In light of the above findings, the study recommends the continuation of targeted public transfers. Specifically, agriculture specific government interventions such as the Command Agriculture and Presidential Input Support Programme have a positive correlation with crop diversification and the use of modern agricultural inputs. It also shows that government food security interventions are accruing to poorer households and presents a case for the continuation of such support.

To the extent that public and private transfers are complementary, the study suggests a role for public policy to better understand and facilitate this complementarity in order to maximise the benefit for the agricultural outcomes of rural households. For example, there could be a role for policy in the harmonisation of public and private transfers to ensure public transfers are channelled towards inputs that are most needed. The study advocates for space to be created in Zimbabwe's policy arena to better understand and explore the interaction between private and public transfers.

Moreover, given the prominence that remittances are given in the National Development Policy framework and the recognition by the government of the need to support the growth of the agricultural sector, the findings suggest that the role of remittances in supporting the agricultural sector should be more explicitly considered and supported. In addition, a proposed agenda for future research is to examine the role of in-kind remittances to determine to what extent they interplay with the agricultural outcomes of rural households.

Another policy recommendation is for the government to prioritise female-headed households in providing food relief and other agricultural interventions given their vulnerability to food insecurity.

The fact that both public and private transfers do not have an association with dietary diversity showcases the lack of diverse nutritional intake by rural households and calls for a better understanding of how this can be achieved. Perhaps policymakers may wish to consider offering more diverse foods when providing food-related public transfers, and/or more diverse seed input, in order to promote the diversification of the diets of rural households.

Lastly, we propose that government interventions that support agricultural productivity and food security should not be homogenous but rather take into account variations in agro-ecological zone.

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