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DOES REMITTANCE OFFSET THE EFFECT OF LOSS OF LABOUR THROUGH MIGRATION ON AGRICULTURAL PRODUCTIVITY IN TANZANIA?

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Abstract

This paper assessed the effects of migration and remittances on the agricultural productivity of households in Tanzania. Using the most recent nationally representative cross-sectional household survey dataset, the three-stage least squares (3SLS) estimate the model to correct for the endogeneity of the remittance variable. The results showed that remittances did not positively impact agricultural productivity in Tanzania. This finding implies that the shortage of agricultural labour due to migration is further worsened by using remittances for household consumption instead of investing in productive agricultural assets. Using the NELM theory as an analytical framework, the findings do not support the argument that remittances could relax credit constraints faced by agricultural households as stipulated by the NELM theory.

Keywords: *Migration, remittances, agricultural productivity, Tanzania.*
JEL Codes: *O13, J61, E21, J68.*

1. Introduction

Agriculture is the main sector that employs the majority (68%) of the population in Tanzania (FAO, 2018). About 73% of households in Tanzania are engaged in agricultural activities (Wineman *et al.*, 2020). Agriculture contributes to 31% of the GDP and 24.9% of the annual export earnings of Tanzania (FAO, 2018). Despite the important role that agriculture plays in the Tanzanian economy, the sector is plagued with several challenges, including low productivity of the sector, among many others. The marginal productivity of labour and land remains low in the agricultural sector in Tanzania. Technology adoption to drive agricultural productivity is very low in Tanzania. The country's low productivity in agriculture is primarily due to limited access to agricultural inputs (FAO, 2018). The majority of farmers rely on traditional farming methods with less mechanisation. Data from the National Panel Survey 2019-2020 revealed that 65% of farming households owned hoes, while less than 1% and 5.84% owned a tractor and a plough, respectively.

FAO (2018) estimated that, on average, 1.9% of smallholder farmlands are irrigated. This exposes the agricultural sector of Tanzania to rainfed agriculture. Furthermore, changes in rainfall patterns due to climate change further worsen the productivity gap in Tanzania. Regarding the adoption of fertilizer and pesticide use, data from the National Panel Survey 2019-2020 revealed that only 14.97% and 26.48% of households apply pesticides and fertilizer to their farms, respectively.

Migration from Tanzania has increased since 2010, significantly increasing remittance flows to the country. Data from World Bank estimates that remittance inflows to Tanzania increased from $40 million in 2009 to $433 million in 2019. Over the last decade, remittance

flow to Tanzania has been steady and remains above receipts of 2010 inflows. As widely reported in the literature, migrant remittances contribute immensely toward reducing liquidity constraints and enhancing productivity among agricultural households (Kapri & Ghimire, 2020; Huy & Nonneman, 2016; Amuedo-Dorantes & Pozo, 2011; Maharjan et al., 2013; Chodi, Jaimovich & Montes-Rojas, 2012; Stark & Bloom, 1985). For instance, Chodi, Jaimovich and Montes-Rojas (2012) and Huy and Nonneman (2016) found that agricultural households that received remittances could increase their farm output by undertaking relevant investments related to farming and other output-enhancing activities. Kapri and Ghimire (2020) also remarked that remittances could increase productivity by facilitating investment in modern farm machinery and technology.

Farming households in the rural areas of sub-Saharan Africa, including Tanzania, are mostly poor and subsist on low incomes with limited access to credit. Consequently, they depend on internal and international migration as a buffer against poverty. Evidence from the literature suggests that in view of credit constraints facing households, remittances can substitute for credit (Stark & Bloom, 1985; Wouterse, 2010; Amuedo-Dorantes & Pozo, 2011). Households with migrants can use remittances to protect themselves against credit and insurance market imperfections. In addition to reducing risk and credit constraints, migration and remittances can increase the use of new or improved agricultural technologies (Quinn, 2009; Zahonogo, 2011).

The depth of literature on the relationships between remittances and agricultural productivity is very limited, either at the household level or at the national level in Tanzania. The only study on remittance and agriculture in Tanzania is by Msinde and Salehe (2017), which studied the effects of remittances on farm input expenditure. However, farm input expenditure does not necessarily translate into productivity if the household does not make the right input mix decisions. The existing studies on the relationships between migration, remittance and productivity are complex and vary with specific local conditions (Akpan et al., 2014). The effect of migration and remittance nexus on agricultural production is not conclusive; while some literature suggests that remittance has a positive impact on agricultural productivity, others find a negative effect of remittance on agricultural productivity (Rozelle et al., 1999; Taylor et al., 2003; Kapri & Ghimire, 2020; Dedewanou & Kpekou Tossou, 2022). The inconclusive effects of migration and remittance nexus on agricultural productivity present a gap in the literature. This paper, therefore, aims to fill the gap in the literature for the case of Tanzania by assessing the impact of remittances on agricultural productivity using a good representative sample of data in Tanzania. To estimate the effects of remittance on agricultural productivity in Tanzania, the paper follows Zahonogo (2011) and Li et al. (2013) and proceeds to use instrumental variable three-stage least squares to correct for endogeneity among migration and remittance.

An important contribution of this paper to the literature is that it estimates the productivity of the entire production of the household in contrast with the single crop productivity analysis by existing studies. To the best of our knowledge, this paper is the first study to attempt to estimate the effects of remittances on the productivity of all crops produced by the household. This analysis captures households' decision-making on crop choices, thus, the best crop combination to yield maximum household productivity. The paper contributes to the existing literature on the effect of the migration remittance nexus on agricultural productivity.

The new economics of labour migration hypothesised that remittances from migration are a strategy to reduce the financial liquidity constraints of rural households (Stark & Bloom, 1985). This study, therefore, assesses whether remittances could provide resources to overcome the constraints on agricultural productivity. The study hypothesised that agricultural households with access to remittances would have additional financial resources to overcome liquidity constraints that negatively affect production. This study uses the World Bank's Living Standard Measurement Survey data from Tanzania to examine the relationship between

remittances and agricultural productivity. Using nationally representative data from Tanzania, the study presents new evidence to increase the understanding of the use of remittances by receiving households.

The rest of the paper proceeds as follows: section two presents the theoretical framework, a brief overview of the literature is discussed in section three, and section four presents the methodology. Next, the results and discussions are presented in section five, and finally, the conclusions are presented in section six.

2. Theoretical Framework

The study relied on the New Economics of Labour Migration Theory (NELM) (Stark, 1991) to analyse the relationship between remittance and agricultural productivity. Following from Tuladhar (2014), the study assumed a neoclassical farming household that seeks to maximize farm output (Q) subject to constraints (T). The constraints in this model refer to credit and technology constraints facing the farming household. Since households face credit constraints in Africa, relaxing credit constraints will improve productivity by adopting high-yielding technology (Tuladhar, 2014).

Suppose the household invests fixed resources (T) in agricultural technology (f_i = 0, 1). The household characteristics (Z) also influence productivity, given the technology. Given a production possibility frontier under resource constraints, and relative price ($\frac{P_1}{P_0}$). A household will choose a high-productivity technology $Q^* = f_1(T, Z)$.

The household is faced with constraints on high-productivity investment $0 < \mathrm{C}(T_1) \leq K$. Where $\mathrm{C}(T_1)$ denotes the cost of adopting the technology, and K is the available credit for investment by the household. Remittances contribute to productivity by relaxing the credit constraints facing the receiving household.

The NELM theory proposes that $K = g(R, M)$, where R and M are remittances and migration, respectively. The constrained resource allocation to high technology is given by $T^c = \emptyset(K), where\ \emptyset(K) > 0$. The constrained output under high technology is given by $Q_1^c = f_1(T_{c1}, X)$ and that of low technology is given by $Q_0^c = f_0(T - T_{c1}, X)$. The constrained output per unit of T, Q^c is given by:

$$Q^c = \frac{Q_1^c + Q_0^c}{T}$$

3. Literature Review

Three main theories are identified in the literature conceptualising migration and remittance's effect on agricultural production and productivity. First, the literature identifies agricultural household models (Singh et al., 1986), neo-classical migration and the new economics of labour migration (NELM) (Stark & Bloom, 1985). The neo-classical migration theories include the surplus of labour theory (Lewis, 1954), the "push-pull" model (Lee, 1966) and the migration model (Todaro, 1969). Second, the agricultural household models seek to assess the transmission of public policies on agricultural activities that affect households' production decisions. Third, the neo-classical migration theories explain the relationship associated with migration and the distribution of factors of production. Finally, NELM theory views migration as a permanent livelihood strategy to diversify household income sources through remittances to overcome risks and credit constraints.

The literature on migration and remittance effects on agricultural production and productivity is inconclusive. Most empirical studies on the subject are in Asia and Latin America. This is usually due to the large inflows of remittance to those regions compared to other regions. Three main strands of literature examine the effect of remittance on agricultural

production. The first group of studies show the negative effect of remittance on production; the second shows positive effects, and the third group of studies show no effect on agricultural production. Among the studies that showed a negative effect, Harden (1996) and Tuladhar et al. (2014), who studied the effects of remittance on agricultural production in Ecuador and Nepal, found that remittances negatively impacted agricultural production. On the other hand, Lim and Simmons (2015) concluded that remittances flowing to the Caribbean countries were mostly spent on consumption rather than investments. Similarly, and more recently, Dedewanou and Kpekou Tossou (2022) also found negative effects of remittances on agricultural productivity using three different productivity measures.

On the other hand, other strands of literature found positive effects of remittances on agricultural productivity. For example, using household survey data from Nepal, Kapri and Ghimire (2020) assessed the relationship between migration, remittances, and agricultural productivity. They found that remittances had a positive and significant effect on productivity. Similarly, Li et al. (2013), in a study of small farming systems in northwest China, found that the loss of production resulting from losing family labour on lower-return grain crop production is likely to be offset by the gain from investing in capital-intensive and profitable cash crop production.

Among the third group of studies that showed no significant effect of remittance on agricultural production, Jokisch (2002) found that remittances did not improve agricultural production in Ecuador. The study showed that there was no difference in the yield between households that received remittance and households that did not receive remittance. Similarly, Maharjan et al. (2013) studied agricultural production and remittances in Nepal; the study found that remittances had no significant effect on agricultural investments.

4. The Methodology

4.1 The Estimation Techniques

Since the households will be producing different crop varieties with different technologies, the study uses the gross output value per acre to assess the productivity of the households. To capture households' decision-making on crop choices, the study used gross value of all cultivated crops. Again, another motivation for using all crops cultivated was that most households (50.99%) used intercropping on their farms. To analyse the effects of remittance on agricultural productivity following Zahonogo (2011) and Li et al. (2013), the basic model would be expressed as:

$$Y = \beta_0 + \beta_1 Rem + \beta_2 Mig + \beta_3 X + \beta_4 T + \varepsilon \quad (1)$$

Where Y, Rem, Mig, X and T are the gross value of output per area, remittances, migration, household characteristics (age of household head, household size, sex of household head, years of education of household head, location of household) and production technologies (irrigation, pesticides and fertilizer) respectively. β_i are parameter estimates, with ε being the random error term representing other factors outside the control of the household and measurement errors during the survey. The null hypothesis is that β_1 and β_2 are equal to zero; thus, neither remittances nor migration impacted agricultural productivity. This means that if the estimated parameters β_i are significantly non-zero, so the study can conclude that remittances and migration affect agricultural productivity.

However, migration and remittances are endogenous, which raises issues of endogeneity and simultaneity in the estimation techniques. The study will employ the instrumental variable method to address these problems during estimations. A good instrument should strongly

correlate with the endogenous variable without affecting the dependent variable (Tuladhar et al., 2014).

Remittances are sent by family members who have migrated elsewhere; hence remittance is a function of migration and household characteristics. This is expressed as:

$$Rem = \gamma_0 + \gamma_1 Mig + \gamma_2 X_R + \varepsilon_R \quad (2)$$

Also, migration is a household decision; hence migration is a function of individual, household and community characteristics. Therefore, the reduced form is represented as:

$$Mig = \delta_0 + \delta_1 X_M + \varepsilon_M \quad (3)$$

Where X_M represents household and community characteristics affecting migration. The socio-demographic variables included income, household, and farm characteristics and equations (1) to (3) constitute a recursive system. However, migration and remittances are endogenous in these systems of equations; hence the parameter estimates to be estimated will be biased when endogeneity is not corrected.

Table 1. Descriptive Statistics of Variables Used by Countries

Variable	Mean	Std. Dev.	Min	Max
Remittances	163135.9	542015.8	0	7000000
No. migrant	0.650338	1.79	1	14
Sex	0.754015	0.430852	0	1
Age	45.32037	16.37803	18	98
Household size	4.721048	3.281743	1	35
Years of education	6.534983	3.940372	0	18
Access to credit	0.147208	0.354463	0	1
Gross value/acre	1458185	9016882	6.61157	1.67E+08
Fertilizer	0.264803	0.441591	0	1
Pesticide	0.149671	0.357042	0	1
Irrigation	0.016208	0.126375	0	1
Access to ext. service	0.102069	0.302948	0	1
Rural/urban location	0.509291	0.500125	0	1
Hired labour	0.360197	0.480453	0	1
Farm size	3.311939	8.168872	0	93.84
Livestock ownership	0.210616	0.407921	0	1
Dependency ratio	0.878463	0.87331	0	9
Migrants network	0.362331	0.480877	0	1
District average of migrants	0.645979	0.537041	0	14
Access to bank account	0.251269	0.433927	0	1
Use of Momo account	0.759149	0.427782	0	1

There is also the potential problem of selectivity bias since not every household has migrant members or receives remittances from migrants. The random error term $\varepsilon_i, i = M, R$ are assumed to be normally and independently distributed with variance σ_i^2. Since the independent variables, which affect migration, can also affect productivity and remittances, the three disturbances are likely to be correlated (Li *et al.*, 2013). The three-stage least squares (3SLS)

is used to estimate the model to resolve the potential correlation among the three equations. The instruments used in this study are the average number of migrants in a district and migrant network for migration, access to a bank account and mobile money as instruments for remittances. The average district number of migrants, excluding the number of migrants of an observation household as a variable, is highly correlated with the number of migrants, but it has no causal effect on productivity. Again, the length of stay of migrants is an indication of the level of experience and network of the migrants. Even though the level of experience influences the amount and frequency of remittances, it does not directly affect the productivity of the receiving household.

4.2 The Data and Variables

This study used the most recent available World Bank's Living Standard Measurement Study dataset for Tanzania. The National Panel Survey (NPS) 2019-2020 is the most representative national household survey and the most recently available for this study in Tanzania. The NPS is a multi-purpose survey of households designed by the World Bank in partnership with the Tanzanian National Bureau of Statistics; it collects information on the different dimensions of living conditions of households in the country. In addition, the NPS has data on agriculture, socioeconomics and other variables. The data on agricultural production and agricultural inputs, as well as household demographic characteristics, are useful in estimating the agricultural productivity of households. The datasets used in this study sampled a total of 1 184 households.

We define household agricultural productivity as the gross value of all crops the household produced in a given production year per area of farm size. This measure of productivity is derived by multiplying the quantity of each crop produced by the corresponding farm gate prices. The values of individual crops are then summed up for each household to arrive at the household aggregate crop value.

5. Empirical Results

5.1 Determinants of Remittances

The study estimates the determinants of remittances to assess the influence of migration on remittances, as well as other household socio-characteristics. Migrant household members send remittances; therefore, migration is surely endogenous with remittances; hence using OLS to estimate the remittance model will produce biased estimated parameters.

Table 2. First-stage Regression Test

Minimum eigenvalue statistic = 614.859					
		Critical values			
		10%	15%	20%	25%
LIML size of nominal 5% Wald test		8.68	5.33	4.42	3.92
Summary statistics					
R-square	0.6197				
Adj. r-square	0.6167				
Partial r-square	0.5245				
Prob > F	0.0000				
Over-identifying restrictions test					
Sargan (score) chi-sq (1)		.000181		(p = 0.9893)	
Basmann chi-sq (1)		.000179		(p = 0.9893)	

The study used instrumental variable two-stage least squares estimation to assess the effects of migration on remittances. The first-stage regression yielded an r-squared value of 61.97%. The f-statistic was significant at 1% and an eigenvalue of 614.86, which is greater than the "LIML size of nominal 5% Wald test" and all the critical values. This indicates that the instruments used for migration are strong; hence the null hypothesis that the instruments are weak, is rejected. The study performed an identification test to test the instrument's validity in the remittance instrumental variable estimation. The Sargan chi2 and Basmann chi2 both had large p-values. This shows that the structural equation for the remittance model was well specified.

The results of the instrumental variable 2-stage least square estimation are presented in Table 3. From the results, household remittances are mainly influenced by the number of migrants, sex of household head, age of household head and household size. While the number of migrants and the age of household head positively influence remittances, the sex of the household head and household size influence remittances negatively. The results indicate that migration affects the amounts of remittances received by households. The results show that the coefficient of migration is estimated at 81,843.82, which is significant at a 1% level. This means that all things being equal, an additional migrant increases remittance received by a household by nearly 82,000 shillings. This result is consistent with the *a priori* expectation. Therefore, the number of migrations is expected to affect the number of remittances received positively. The result is also consistent with the literature. For instance, Kapri and Ghimire (2020) found that migration positively influences remittance inflows.

Table 3. Determinants of Household Remittances

Independent variables	**Estimated parameters**	**Robust std. error**
Migration	81,843.82 ***	20,843.18
Sex	-248,689.4***	39,121.64
Age	2,572.55**	1,124.34
Household size	-19,717.27***	6,054.26
Education of head	5,767.178	5,055.203
Bank account ownership	-6,653.219	69,247.59
Use of Momo account	36026.19	39379.37
Location	25,985.07	33,876.53
Constant	201,580.4	81,585.64
No of observations	1,125	
R^2	0.0783	
Prob > chi2	0.0000	

Note: ***, ** and * indicate 1%, 5% and 10% significance levels, respectively.

The relationship between migration and remittances provides further motivation for the main objective of this paper. While migration negatively impacts the availability of family labour for agricultural activities, we find that migration also increases the amount of remittance inflows. Hence the ultimate impact of remittance on agricultural productivity will depend on the stronger driving force between migration and remittances.

Another determinant of receipt of remittances is the sex of the household head. The result indicates that, on average, male-headed households receive 248 689.4 shillings less than female-headed households. The intuition behind this result is that most female-headed households have migrant husbands and remitting to the household. A related variable that shares a similar relationship with remittances received is household size. Again, the result indicates that larger households receive fewer remittances than smaller households. While there is no theory between household size and remittances, intuitively, it can be interpreted

that all things being equal, households sending out migrants are likely to have smaller household sizes than non-migrant households. Already we found that migration has a positive effect on remittances; hence, it is valid to conclude that smaller households with relatively more migrants will have more remittances.

5.2 Effects of Migration and Remittances on Agriculture Productivity

The results of the 3-stage least square regression are presented in Table 4. The results show a negative relationship between remittances received and the gross output value per acre. Specifically, additional shillings received reduced gross farm output per acre for the receiving households. The coefficient of remittance in the model is significant at a 1% significance level. This relationship between remittances and gross farm output per acre indicates that remittances received by households in Tanzania are mainly used for consumption purposes. This result is consistent with the literature as there are mixed results in the literature. For example, Jokisch (2002) found that remittances did not improve agricultural production, similar to the findings of Tuladhar et al. (2014) who found that remittances negatively impacted agricultural production in Nepal. Akpan et al. (2014) found that remittances negatively impacted yields in Nigeria. The remittances were not used to acquire agricultural technology to invest in their farms. Unsurprisingly, the agricultural technology inputs included in the model were not statistically significant except for irrigation use.

The use of irrigation positively affected gross value per acre, and the coefficient was statistically significant at a 1% significance level. Households that used irrigation for their farming activities had at least 224,000,000 shillings more than households that did not use irrigation. This result is consistent with *a priori* expectation as irrigation is a key infrastructure for ensuring all year-round crop cultivation.

Access to extension services positively affected the gross output value per acre. This result is not surprising because, all things being equal, farming households with access to agricultural extension services will be informed about the modern technics of farming and applying good agricultural practices on their farms. Other farm-level characteristics that affected gross value per acre is the size of the farm. The results show that smaller farms are relatively more productive than bigger farms. The inverse relationship between farm size and agricultural productivity is well-documented in Tanzanian literature and general literature on farm productivity. Julien et al. (2019) found an inverse relationship between farm productivity and land size in Tanzania.

To account for variations across location and other unobservable effects, the study used rural and urban locations as a dummy variable in the model. The main location-specific data collected in the survey were from Dar es Salaam, Zanzibar, mainland rural and mainland urban. However, due to collinearity among the variables, Zanzibar was dropped out of the model; hence, the study collapses all four locations into rural and urban. From the result, urban farming households were found to have a higher gross value of farm output per acre than rural farming households.

Even though the first and second-stage regressions in Table 4 were not the objects of the study, instruments were used in models (1) and (2) to avoid possible endogeneity bias problems in the 3 SLS. The instruments: average district number of migrants, migrant network, and use of mobile money account were statistically significant at a 1% level.

Table 4. Effects of Migration and Remittances on Agriculture Productivity (3 SLS)

Independent variable	(1) No. of migrants	Dependent variable (2) remittance	(3) Gross value/acre
Migration Effects			
Remittance			-30.40*** (7.33)
Migration		60802.28** (25031.82)	1475283 (813558.4)
Household characteristics			
Sex of head	-0.231** (0.091)	-90308.77 (51968.3)	-5030560*** (1667291)
Age of head	-0.003 (0.003)	4820.883*** (1502.758)	122040.4** (53834.54)
Household size	0.115*** (0.011)	-18450.29** (7160.237)	-264099.7 (231267.3)
Education of head	0.010 (0.011)	5777.264 (6785.213)	330381.6 (189172)
Dependency ratio	-0.118*** (0.036)		
Rural/urban	0.085 (0.086)	85036.4 (49267.77)	4203727*** (1535234)
Agricultural inputs			
Fertilizer			1570637 (973026.7)
Pesticide			-1583466 (1265794)
Irrigation			2.24E+07*** (4231781)
Extension service			3374790** (1527089)
Hired labour			1922716 (1139162)
Farm size			-105867.9** (53419.71)
Access to credit			-1887206 (1208755)
Livestock ownership	-0.050 (0.079)		-1874624 (1017965)
Instruments			
District average migrant	0.336*** (0.050)		
Migrant network	1.574*** (0.078)		
Bank account ownership		-81436.42 (45737.72)	
Use of Momo account		104222.3*** (37255.08)	
Constant	-0.407** (0.180)	-84857.42 (103234.6)	904732.2 (2908584)
No of observations	**448**	**448**	**448**
Chi^2	**809.73**	**41.65**	**107.30**
Prob > F	**0.0000**	**0.0000**	**0.0000**

Note: *** and ** indicate 1 percent and 5 percent significance levels respectively.

5.3 Test of Endogeneity

The study tested for endogeneity between migration and remittances using two approaches, and both confirmed the endogeneity of migration and remittance. The test for endogeneity is conducted using the Hausman-Wu test for endogeneity. The first approach of the Hausman-Wu test for endogeneity involves a two-step procedure; first, the study estimates the migration equation (3) and then saves the predicted error term. The second step involves using the saved error term as an independent variable in the remittance equation (2). The results of the Hausman-Wu test show that migration is endogenous in both the remittance equation (2) and productivity equation (1). In both models, the predicted error term of migration used as an independent variable was found to be significant at a 1% level (*p-value* =0.000). The second approach was to estimate the productivity equation using instrumental variable two-stage regression and test for endogeneity of remittance and migration in the model. The test for endogeneity using the Hausman-Wu rejected the null hypothesis of migration and remittance being exogenous variables at a one% significance level. The results of the Hausman-Wu test in both approaches justify using the three-stage least square estimation method to estimate the effects of remittance on the agricultural productivity of the households since migration and remittance are endogenous.

5.4 Test of Validity of Instruments in the Two-Stage Instrumental Variable

The study tested for the endogeneity of migration and remittances using a two-stage instrumental variable estimation method, as described in section 3.8.3 above. In controlling for endogeneity using the instrumental variable estimation technique, the strength and validity of the instruments used in the estimation must be tested to determine the fit of the entire structural model. The study used the test for overidentification to test whether the structural equation was well specified and the model's fitness. The minimum eigenvalue statistic is greater than the "LIML size of nominal 5% Wald test" at 15%, 20% and 25%, respectively. The study, therefore, rejects the null hypothesis that the instruments are weak. This shows that the instruments used in the two-stage least square estimations are strong in that order. Again, the overidentifying restrictions test of Sargan chi^2 and Basmann chi^2 shows that the structural equations are well specified.

6. Conclusions and Recommendations

Using the latest nationally representative cross-sectional household survey data, the study assessed the effects of migration and remittances on the agricultural productivity of households in Tanzania. The results showed that remittances did not positively impact agricultural productivity in Tanzania. This finding implies that the shortage of agricultural labour due to migration is further worsened by the use of remittances for household consumption instead of investing in productive agricultural assets. Using the NELM theory as an analytical framework, the findings do not support the argument that remittances could relax credit constraints faced by agricultural households as stipulated by the NELM theory. From the findings of this study, we provided insight into the possible allocation of remittances through the endogenous approach to household consumption. It is suggested that further research should examine whether remittances improve the welfare of crop-farming households in Tanzania.

Given that access to the agricultural extension has a positive effect on productivity, the general policy implication from this study is that the extension officer must pursue a deliberate effort to provide financial literacy to farming households to enable them to invest remittances into productive use rather than consumption. The result also shows the relative importance of

smallholder farmers in Tanzania, as small farm sizes are comparatively more productive than larger farms. Therefore, policies that ensure farmers access productive agricultural inputs should give more attention to smallholder farmers. Since migration already results in the loss of productive labour from rural areas, access to productive inputs by remaining farm households will help to mitigate the overall negative impact on agriculture production and productivity caused by migration.

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Appendices

Appendix 1. Test of endogeneity of migration and remittance and validity of instruments used

Ho: variables are exogenous
Durbin (score) chi2(2) = 9.82309 (p=0.0074)
Wu-Hausman F(2,453) = 4.79328 (p=0.0087)
Sargan (score) chi2(2) = 0.385459 (p=0.8247)
Basmann chi2(2) = 0.368681 (p=0.8317)