Participation in Informal Off-farm Labor Market and its Impact on Household Income and Food Security in Malawi

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Abstract

Most rural households in Malawi often opt to supplement their farm income with additional casual work on the farms of others ("ganyu" labor). However, there is a growing concern that such informal off-farm work will eventually drive rural households into absolute poverty. Using data from a 2010 Malawi household survey, this study seeks to explore this conjecture, first by examining the factors that motivate rural households to participate in informal off-farm work (ganyu) and later evaluate its outcome. Results from the average treatment effect indicate that participating in ganyu increases an individual's annual total off-farm income. On the other hand, it has a negative effect on own-farm income.

Key words: farm labor, ganyu, matching estimator, treatment effect, off-farm income, food security, poverty

Introduction

In Malawi, as in other developing countries, food security is highly dependent on agricultural productivity. Agriculture is characterized by small holdings which depend heavily on variable rainfall (McSweeney *et al*., 2008). This dependency has left most rural households as net buyers of staple food crops to meet their subsistence requirement during deficit periods, particularly during prolonged droughts. Off-farm work has been a major source of income to buy food during such periods. Anderson (2002) underscored the relative importance of off-farm income to the household livelihood in many developing nations. Informal off-farm labor is not unique to Malawi but common in most developing countries. The main reason making it insignificant to economic development is the lack of clear policy frameworks that promote this type of off-farm sector.

A number of studies indicate that the vast majority of rural households in Malawi are close to, or below the subsistence threshold (Devereux, 1999). This has made them opt for less-risk, low-return economic activities like ganyu that seem to lower the risk of hunger in the short run but may have a negative effect on the rural community in the long run (Barrett *et al*., 2001). Most rural households participate in various informal off-farm income generating activities to supplement proceeds from their own farms and other formal sources. Informal off-farm labor opportunities (ganyu) have often been described as survival strategies for the rural poor. Ganyu is a form of casual work that does not require any formal education or training. It is the most available job opportunity for one to make quick cash. It also involves a lot of physical work done on the farms of others. There is a growing concern that ganyu, which is one of the survival strategies, will eventually drive Malawi rural households into absolute destitution (Whiteside, 2000).

Most studies dealing with the state of agriculture in Malawi identify small land sizes, credit constraints, and fertilizer shortages as the main factors motivating ganyu participation (Alwang and Siegel, 1999; Orr, 2000; Orr and Mwale, 2001; Ellis *et al*., 2003; Harrigan, 2003). There is also a positive reaction of ganyu labor supply to periods of environmental shocks: floods, pests, and diseases. Ganyu is therefore seen as a survival strategy for poor farm households, especially when agricultural production is very low and after periods of loss of farm produce following severe weather conditions or crop pests and diseases.

Ganyu has often been described as a paradoxical risk management mechanism (Dimowa, Michaelowa, and Weber, 2010). According to a report from the Second Integrated Household Survey (HIS) 2004 conducted by Malawi National Statistics Office, about 52% of all rural households offered ganyu labor. Simpson and Kapitany (1983) found that non-farm earnings assisted young individuals in financing their farm investment requirements. Other studies have noted that risk-averse farmers resort to off-farm employment as a risk management strategy (Mishra and Goodwin, 1997).

Devereux (1999) argued that ganyu, also dubbed as a survival strategy for the poor, essentially prevents poor households from extreme destitution. He further discussed the crucial role played by ganyu participation when farm households face demand-side constraints for goods they cannot produce on their own farms. Ganyu is seen as a means used by poor rural households to smoothen consumption through such deficit periods. Mishra and Sandretto (2002), in their study of farm household income variability, concluded that off-farm income has been a major factor in stabilizing total household income. With alternative income sources, rural households have been able to meet most of their consumption needs. The current study therefore attempts to address these conflicting ideas/claims concerning the impact of ganyu on rural livelihood.

General objectives of this study are to investigate the contribution of ganyu participation on rural households' income and food security status. Specific objectives are:

1. Evaluate the determinants of ganyu labor supply
2. Estimate the direct impact of ganyu labor participation on rural households' total off-farm income (income effect), food consumption (consumption effect), and its indirect impacts on households' farm productivity (production effect).

Results from this study not only support some conjectures already made in the literature, but also reinforce the importance of ganyu participation to the rural poor. A mutual interaction of ganyu participation with government support through policy could play an important role in developing safety nets (Whiteside, 2000).

Food Security in Malawi

World Food Program (WFP) defined food security as, "access by all people at all times to the food needed for an active and healthy life". It is widely accepted that lack of adequate food, whether chronic or transitory, is one the principal indicators of poverty (IHS report, 2012). Food insecurity is still a major public policy concern in many developing countries. Agricultural development is crucial in addressing this problem. Diao et al., (2007) notes the importance of both agricultural and non-agricultural efforts in solving problems of hunger and poverty in the developing economies. Smallholder farm households participate in off-farm work as a secondary complementary economic activity to boost their total household income (Barrett et al., 2001). With declining farm profits, households opt for off-farm activities, a situation described by Babatunde and Qaim (2010) as "distress push" diversification. Population growth, deteriorating arable lands, and crop and market failures further push rural households out of farming. Green

and Baden (1994) argued that small farm sizes less than 0.5 hectares could be a constraint most likely to reinforce a positive effect on ganyu supply as an alternative means of securing income.

Rural households have sought different survival mechanisms to overcome food insecurity problems. Chang and Sumner (2003) found that Chinese farm households participating in off-farm labor are more food secure than their counterparts. Ruben and van den Berg (2001) in their study of Honduran farm household found that food consumption is strongly enhanced through engagement in non-farm activities. Ganyu is the most adopted coping strategy by poor households in Malawi during crucial hungry periods to bridge the deficit between food stock running out and the next harvest (Whiteside, 2000). The fourth report of a series of the IHS conducted by the Malawi National Statistical Office (NSO) identified some coping mechanisms that rural households resort to when faced with food scarcity. Table 1 classifies these coping mechanisms on the basis of location, gender of the household head and marital status.

According to the NSO (2010 – 2011) IHS report, the most common coping mechanism among the groups studied was relying on less preferred food, representing 30.7%, followed by reducing the amount of food served at every available meal, 24.3%. Reducing the number of meals per day was the most common coping mechanism for 18.6% and help from others accounted for 12.9%. Ganyu participation was not investigated as a coping mechanism. This study explores this prospect by examining the contribution of ganyu participation on household consumption behavior, which is directly related with food security.

Off-farm labor supply may impact food security in a number of ways depending on prevailing labor and commodity market conditions. It contributes positively to food security on the demand side, but negatively on the supply side. The positive contribution on demand side implies that farm households are able to generate income from ganyu hence able to purchase

food and farm inputs. A negative supply side (effect) results when labor is withdrawn from the farm to participate in ganyu. Whiteside (2000) argued that such labor misallocation impacts own-farm productivity in the long run. Given that ganyu wage is low relative to wages from other formal off-farm work, the opportunity cost of participating in ganyu is usually high.

A backward bending ganyu supply curve is experienced during periods of environmental shocks. According to Whiteside (2000), households are willing to supply more ganyu even at very low wage rates, neglecting their own farm activities. The low earnings from ganyu coupled with minimum or zero own-farm production leaves the household at a compromising state of food security in the long run. Following the neoclassical theory of the firm, a household is expected to supply off-farm labor whenever the wage received exceeds the shadow wage received from own-farm. That is not the case here; the binding consumption constraint between own-farm harvesting periods forces many rural households to supply ganyu despite the low wage. Reservation wage analysis is also constrained in estimating ganyu labor. A farm household's decision to participate in off-farm labor market is expected to be positive when the reservation wage for farm work is less than the off-farm wage rate offered (Chang and Mishra 2008)

Methodology

Theoretical framework

Average treatment effect and matching estimators

In this study, we estimated the average treatment effect (ATE) of ganyu participation on rural household income and on quantity of food consumed both from own-farm and that purchased. To assess the impact of ganyu participation, we employ the nearest neighbor matching estimator proposed by Abadie and Imbens (2002). Matching estimators have been

widely applied in many economic studies (Rosenbaum and Rubin, 1983; Rubin and Thomas, 1992; Rosenbaum, 1995; Imbens, 2004; Wooldridge, 2002; Imbens and Wooldridge, 2009; Morgan and Harding, 2006; Nichols, 2007; Heckman *et al.*, 1998). Some applied disciplines such as agricultural economics have also used it (Khanal and Mishra, 2013; Uematsu and Mishra, 2012; Tauer, 2009; Liu and Lynch, 2007). With this method, for each individual i, matching estimators impute the missing outcome by finding other in the data whose covariates are similar but who were exposed to the treatment. This process of matching similar individuals who chose the opposite treatment causes these estimators to be known as "matching estimators" (Abadie *et al*., 2004).

An ideal situation to estimate the ATE is to simply compare two outcomes for the same unit (Imbens and Wooldridge, 2009). We are interested in estimating the average effect of a binary treatment (ganyu participation) on the proxy of food security status: total off-farm income and quantity of food consumed (quantity of food from own farm, and purchased food). For individual *i*, $i = 1, \ldots, \mathrm{N}$, let $\{\mathrm{Y_{i0}}, \mathrm{Y_{i1}}\}$ denote the two potential outcomes: $\mathrm{Y_{i1}}$ as the outcome of individual *i* when participating in ganyu (exposed to the treatment) and $\mathrm{Y_{i0}}$ is the outcome of individual *i* when not exposed to the treatment. Following the Abadie et al. (2004) mathematical formulation, if $\mathrm{Y_0}$ and $\mathrm{Y_1}$ were observable for the individual i, the effect of the treatment on individual *i* (ATE) would be directly observable and can be expressed as: ATE= $\mathrm{Y_1}$-$\mathrm{Y_0}$. This information then could be used for all samples N to calculate the population average treatment effect (PATE) and the sample average treatment effect (SATE) which is expressed as,

$$\mathrm{PATE} = \mathrm{E}(\mathrm{Y}_{i1} - Y_{i0})$$

$$SATE = \frac{1}{N}\sum_{i=1}^{N}(Y_{i1} - Y_{i0})$$

A common practical problem when using cross-sectional data is that only one of the two outcomes is observed because of the mutually exclusive outcomes assumption. By letting the observed outcome be Y_i:

$$Y_i = Y_i(T) = \begin{cases} Y_{i0} & if\ T_i = 0 \\ Y_{i1} & if\ T_i = 1, \end{cases}$$

where T is the treatment. In our study, we estimate the outcome, Y_{i0}, (rural household total off-farm income, quantity of food consumed from own-farm, and that from purchases) for non-participant farm households, with covariates X_i, who were exposed to the treatment. Such an estimation of outcomes for households who did participate in ganyu is the interest of this study. Thus, estimating the ATE of ganyu participation on food security status of rural household centers on the estimation of the counterfactual or imputing missing data (Wooldridge, 2001). For instance, what would have been the rural household income of the treatment households had they not participated in ganyu? We estimate the counterfactual household income, food consumption and expenditure on food for households who did not participate in ganyu using participant households; the average treatment effect of the treated (ATET).

$$\mathrm{ATET} = \mathrm{E}[\mathrm{Y_{i1}} - \mathrm{Y_{i0}}|\mathrm{T} = 1],$$

where T is a binary variable representing treatment status (T = 1 indicates treatment, 0 otherwise).

If the decision to take the treatment (participate) is purely random for individuals with similar values of the pretreatment variables or covariates, we could use the average outcome of some similar individuals who were not treated to estimate the untreated outcome. A researcher cannot randomly assign individuals to either control or treatment groups. Given this, one issue in assessing the treatment impact is whether the existence of ganyu is endogenous or not. The estimate of a causal effect obtained by comparing a treatment group with a non-experimental

comparison group could be biased because of problems such as self-selection or some systematic judgment by the researcher in selecting units to be assigned to the treatment (Dehejia and Wahba, 2002).

An alternative method to solve problems encountered when estimating ATE is to use the propensity score matching estimator. Matching involves pairing treatment and comparison units that are similar in terms of their observable characteristics. Rosenbaum and Rubin (1983) proposed the propensity score for which one can use the predicted probability of being in the treatment estimated using either a logit or a probit model. This method has two main advantages – first, the matching protocol ensures that households participating in ganyu will be matched to non-participant households that are most similar to them in terms of characteristics, thereby ensuring that dissimilar households and outliers will have no/little influence on the treatment impact. Second, it relaxes the treatment exogeneity assumption, and that not all households are equally likely to participate in ganyu and some of the pretreatment covariates may influence the existence of ganyu. By summarizing pre-treatment characteristics of each subject into a single-index variable (the propensity score), this method makes matching feasible (Rosenbaum and Rubin, 1983).

This study uses nearest neighbor matching which takes each treated unit and searches for the control unit with the closest propensity score. This method is usually applied with replacement, in the sense that a control unit can be a best match for more than one treated unit (Becker and Ichino, 2002). An important feature for the nearest neighbor method is that all treated units find a match. It summarizes information from multiple covariates into a single vector norm ||x||v = $(X'VX)^{1/2}$ where V is the positive definite matrix. The nearest neighbor matching sets define the minimum distance between two observations. Denote T_0 as the set of

control units matched to the treated unit *i* with an estimated value of the propensity score of p_i, $T_0 = min_j \|p_i - p_j\|$, where p_i and p_j are the vectors of observable characteristics (propensity scores) for the two observations. T_0 is a singleton set unless there are multiple neighbors. The estimator for ATET is given as:

$$\text{ATET} = \frac{1}{N_1} \sum_{i:T_1=1}^{N_1} [Y_i - \acute{Y}_{0i}]$$

where N_1 is the number of observations in the treatment and subscript *i* represents individual observations. The unobserved outcome, $\acute{Y}_{0i,}$ is estimated by averaging the observed outcomes for the observations of the treatment group that are chosen as matches for *i*; it is expressed in the following way

$$\acute{Y}_{0i} = \begin{cases} \frac{1}{M} \sum_{m \in M_i} Y_m & if\ T_i = 1 \\ Y_i & if\ T_i = 0 \end{cases}$$

where *M* is the number of matched observations and M_i is the set of observations in the control group matched to i^{th} observations in the treatment.

The key assumptions made in using matching estimators are: (1) Common support condition (CSC) or identification assumption. It is the most obvious assumption and it restricts all estimations to positive values $0 < P(T_i = 1) < 1$, the probability of treatment T_i falls between zero and unity. For instance, if $P(T_i = 1) = 0$ or $P(T_i = 0) = 0$, then it is not meaningful to speak of the treatment effect for that individual. (2) Stable Unit Treatment Value Assumption (SUTVA): any remaining difference in the outcome variable after matching can be solely attributed to the treatment status (Imbens, 2004). (3) Strong ignorability of treatment assignment $T \perp \{Y_0, Y_1\} |X$: which implies that treatment is independent of individual observations in a randomized study. Becker and Ichino (2002) noted that assignment to a treatment can be

considered purely random among the matched observations. Rosenbaum and Rubin (1983) termed it as the assumption of "unconfoundedness".

Data

The study used household survey data from the third Integrated Household Survey (IHSE3) conducted by the Malawi NSO between March, 2009 and March, 2010. We obtained this information from the World Bank database. The cross-sectional data provided extensive information on the various aspects of household welfare in Malawi. The target population included households located within randomly selected districts in Malawi. To avoid sample selection bias, four districts located in the southern part of the country are excluded from the study. These districts had experienced a prolonged spell of drought in the year preceding the study. Inclusion of the 4 districts would have biased the per capita consumption estimates and the ATET coefficients. Zomba, Chikhwawa, Nsanje, and Balaka districts are excluded from the study. A total of 12,288 households were interviewed. The variables used in the analysis of our study are listed in table 2.

Results and Discussion

Participation in Ganyu Gabor Force

Our analysis focused on rural households whose main economic activity is subsistence farming. From our analysis of weekly labor allocation, it was found that 80.41% of rural households spent most of their time doing farming (fishing, crop, and/or livestock farming) during rainy seasons. The rural households also participated in off-farm income generating activities such as ganyu to supplement proceeds from their farms. Women supplied a relatively larger proportion of ganyu (51.14%) as compared to men who only supplied 48.86%. Results from our analysis of weekly time allocation indicates that 60.7% of hours were spent on the

farms, 34.4% were spent on other off-farm activities including ganyu, and 3.02% were spent on collecting water (Figure 1).

Table 2 provides the summary statistics of the major variables used in the study. Mean values for the entire sampled population and the disaggregated mean for ganyu participating and non-participating households are provided. Ganyu participants' mean total off-farm income was MWK 21,453.01 while non-participants earned MWK 20,311.53 per month. The average ganyu wage per day was MWK 304.69, which lies slightly below the minimum wage set by the Malawi central government of MWK 313. This confirms previous findings that ganyu represents an additional option for rural households to supplement the low farm wage. Individuals are free to decide whether or not to supply ganyu; neoclassical economic theory suggests that "they can only be better off if this option exists" (Polzin and MacDonald, 1971; Huffman, 1980; Rosenzweig, 1980). The option referred to here is off-farm work (ganyu).

There is pronounced mean disparity between ganyu participating and non-participating individuals for most of the variables listed. It is clear that households participating in ganyu had a relatively higher total off-farm income than non-participants. Mean estimates in Table 2 indicate that most individuals participating in ganyu were young, single, and possessed low levels of education. Ganyu participants were more dependent on purchased food as they spent most of their time away from their own farms. Mean expenditure on food for ganyu participating households was MWK 2813.50 per month while their counterparts spent an average of MWK 1948.13. Here we simply compare the means of each variable for both the treatment and control groups without controlling for any underlying factors. Using a matching estimator would therefore help to overcome this issue and estimate the effect of the treatment variable on the outcome variable (Uematsu and Mishra, 2012).

Estimation of determinants of ganyu labor participation

We estimated a binary probit model of ganyu on a set of explanatory variables defining the farm household. Table 3 reports parameter estimates, standard errors, p-values, and the value of the log-likelihood function. Probit parameter estimates indicate the direction of the relationship between households' decision to participate and the set of independent variables used. The same set of variables used in this model represents a vector of covariates used to calculate distance in matching observations. The probit model is estimated to examine whether variables used in the matching estimator satisfy the balancing property (Becker and Ichino, 2002).

The variables considered for the analysis are: age, years of education, family size, marital status, sex of the household head, total off-farm income, the length of time lived in that area (measured in years), chronic illness, crop farming and livestock farming (Table 3). As expected, both higher education and experience of the households' heads reduced the likelihood of supplying labor in the ganyu market. The less educated, lower income and younger individuals had a higher probability of participating in ganyu labor. Age had a positive impact on the likelihood of household members supplying ganyu labor. However, a turnaround effect is realized at age 50 years when the relationship becomes negative. The sign on both crop and livestock coefficients was negative as expected because labor is substituted away from these activities. Individuals farming their own lands were least likely to participate in ganyu.

Even though some of the factors considered did not have a significant effect on ganyu participation, signs on their coefficients are as expected. The variables education, total off-farm income, and male headed household were found to be statistically significant. The coefficient of education level is statistically significant at the 5% level and has a negative, sign indicating that

the probability of an individual participating in ganyu labor force decreases with education level. The hypothesis of on- versus off-farm literature assumes higher education levels to be associated with an increase an individual's likelihood to participate in off-farm work (Rizov and Swinnen, 2004), which is not the case with ganyu. Male-headed households were more likely to engage in ganyu labor (Table 3).

We applied the delta method to compute average marginal effects (AME) for each case. It is an informative way of obtaining the magnitude of how a change in a covariate is reflected in the response variable. Table 4 presents the AME of the listed variables on the response probability (ganyu participation). Education level is significant at the 10% level, indicating that an additional year of schooling reduced the predicted chances of participating in ganyu by 1.3 percent. A male-headed household was 11.9% more likely to participate in ganyu than a female-headed household.

The Average Treatment Effect

The variables included in the probit model are used to create the distance index for matching of observations in the treated group against those in non-treated group. The Average Treatment Effect for the Treated (ATET) was estimated using m_i where $i = 1….5$. Table 5 presents the ATET of ganyu participation on total farm household income, total off-farm income, number of meals per day for both kids and adults, total expenditure on food, and quantity of food consumed from own farms.

The result indicates that the ATET on the households' total off-farm income is positive for all m = 1, …,5 though significant for only m = 1, 2, and 3. This suggests that the average effect of participating in ganyu labor is associated with an increase in an individual's total off-farm income. The point estimates of ATET indicate that ganyu participants on average earned

between MWK 944 and MWK 1328 more on their total household income per month than non-participants. Such a positive impact translates to an improved households' purchasing power, an indicator of improved livelihood. A study by Ruben and van den Berg (2001) found out that an improvement of 0.3% in food adequacy resulted from a 10% increase in nonfarm income.

The ATET estimates of total off-farm income and total farm income provides evidence of an existing tradeoff between the two economic activities. The ATET on total off-farm income ranged between MWK 5180 and MWK 10580 while the ATET on total farm income was between MWK - 6848 and MWK - 9702. The averages of the two income sources are almost the same. The decision, therefore, on whether or not to participate in informal work instead of own-farming remains with the household head.

Household consumption patterns reveal the net costs and benefits of participating in ganyu by rural households. The estimated ATET on food consumption from own farms and purchase confirm findings from previous research on the impact of ganyu participation on own farm productivity (consequently consumption from own farm produce). Our results indicate that the ATET on quantity consumed from own-farm is negative for all m's as expected. Off-farm activities tend to constrain the labor input available for own farms during peak production periods (Pfeiffer et al., 2009). Use of family labor off-farm reduces labor available to the family farm, which can lead to productivity loss (Ruben and van den Berg, 2001). The average effect of participating in ganyu labor is associated with a decrease in the quantity of own-farm produce as reflected by the reduced consumption of food from own farms. This implies that ganyu participants are less dependent on food from their own farms than non-participants.

A negative sign on the ATET estimate for total farm income implies that ganyu participants may not be able to produce their own food as their efforts become attracted to the

quick cash from ganyu work. The ATET estimates are significant for m = 1, 2, 3, 4 and borderline significant for m = 5 with values ranging from -9,702 to -6,848. A repeated cycle of events from season to season will eventually lead to a complete negligence of own farm production. In the long run, this will have a negative effect on agricultural productivity as the household shifts all its efforts to immediate cash sources at the expense of farming. However, the reverse could also be true. When capital is scarce, off-farm income may be used to relax such a liquidity constraint. The decision on how to allocate off-farm income may also depend on other essential resources such as land and household strategies in a specific context. Kilic et al. (2009) found that rural households in Albania tended to use their off-farm earnings to move out of agriculture, whereas Oseni and Winters (2009) showed that off-farm activities in Nigeria helped households improve their farm productivity by enabling them to acquire inputs to use in their farms. A positive ATET on purchased food for all m = 1… 5 indicates that ganyu participants were more dependent on purchased food than what they produce from their own farms. Ruben and van den Berg (2001) obtained similar results for Honduras households. Ersado (2003) showed that non-farm income diversification was associated with a higher level of consumption expenditure in Zimbabwe. Babatunde and Qaim (2010) found out that an increase in annual off-farm income by 1,000 naira per adult equivalent (AE) resulted in an average consumption improvement by 22 kcal per day.

Summary and Conclusion

This study investigated the impact of ganyu participation, non-formal work outside the farm, on income, consumption, and food security of rural households in Malawi. A probit model was estimated to analyze the factors determining ganyu participation. The nonparametric

matching estimator was implemented to estimate the average treatment effect of ganyu participation on household well-being.

Our results suggest that ganyu plays an important role in rural households as a mechanism used in smoothening consumption when households run out of stock of food from their own farms. Results showed a significant effect of ganyu participation on household income, consumption and food security patterns. The ATET results provide insight into household time endowment decisions revealing clearly the net outcome associated with such decisions. Results from this study brace the idea of a typical off-farm labor supply mechanism explored in the income diversification literature that focuses on ways to escape poverty (Orr et al., 2009; Barrett et al., 2001; Reardon et al., 1992; Dercon and Krishnan, 1996).

We found out that the average effect of participating in ganyu labor leads to a decrease in consumption of food from own farm. Ganyu participants tended to rely more on purchased food. This seems plausible because ganyu participants might not be able to work adequately in their farms as they allocate most of their time outside the farm supplying ganyu for immediate needed cash. Most farm operations are neglected, leading to low farm productivity. A resulting food shortage will force them to look for more ganyu and other off-farm income generating activities to supplement the low farm productivity from year to year. This cycle seems to persist in absence of a policy intervention. Results from this study are consistent with Whiteside (2000) on the rationale that subsistence constrained households tend to supply more ganyu at a lower wage, neglecting production in their own fields. The low income received from nonfarm work, coupled with the decreased productivity from neglected own farms may push these households into a poverty trap. This has an important implication for policy makers to develop strategies that can help poor households balance the two competing activities.

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Table 1 Coping mechanisms during periods of inadequate food supply

Characteristics	Relied on less preferred food (%)	Limited portion size at mealtimes (%)	Reduced the number of meals (%)	Reduced consumption by adults (%)	Borrowed food or relied on help from others (%)
National	30.7	24.3	18.6	10.3	12.9
Location					
Urban	25.8	17.5	15.5	9.0	7.5
Rural	31.6	25.6	19.2	10.5	13.9
Rural North	35.9	23.9	19.9	12.7	14.1
Rural Centre	21.1	23.0	13.9	7.9	14.2
Rural South	40.4	28.5	24.1	12.4	13.5
Northern region	33.9	22.2	18.6	11.4	13.3
Central region	20.9	21.6	13.3	7.2	12.6
Southern region	39.2	27.6	23.8	12.9	13.1
Household head					
Male	28.6	23.3	17.3	10.0	12.0
Female	39.4	28.7	24.1	11.5	16.8
Marital status					
Married	28.6	23.2	17.3	10.1	12.1
Divorced	38.4	29.4	23.3	8.7	16.8
Widowed	42.3	30.4	26.7	13.7	17.3
Never married	25.0	16.1	13.5	7.1	8.0

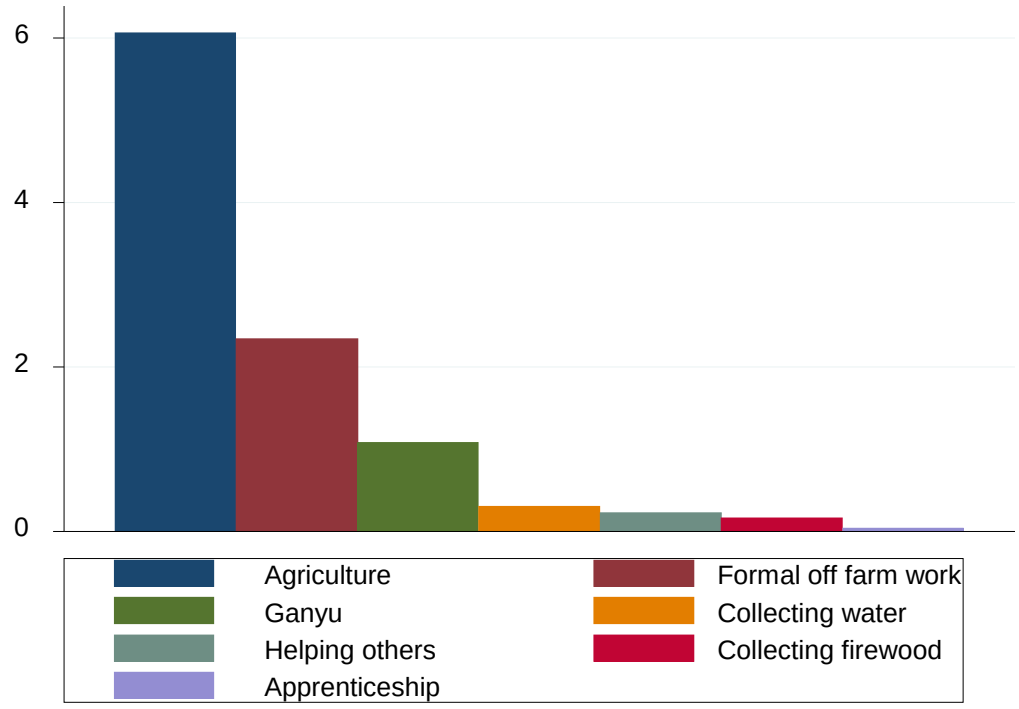

Figure 1: allocation of labour among differnet activities in Malawi.

Table 2 Summary statistics of ganyu participation

Variables	*Mean*			
	Entire sample	Ganyu	Non-ganyu	T/Z score
Formal off-farm income (MWK per month)	19555.38	12045.95	20311.53	5.10***
Informal off-farm/ganyu income (MWK per month)	9407.06	9407.06	-	-
Total off-farm income (MWK per month)	28962.44	21453.01	20311.53	2.08**
Total farm income (MWK per month)	2688.07	3300.15	2348.06	1.08
Age (in years)	43.83	44.47	42.03	-64.28***
Household size	5.76	4.94	5.93	30.00***
Male-headed household (= 1 if male, 0 = otherwise)	0.17	0.36	0.13	-56.86***
Marital status				
Single (=1 if single, 0 otherwise)	0.11	0.93	0.27	53.59***
Monogamous (= 1 if monogamous, 0 otherwise)	0.86	0.93	0.66	-62.60***
Polygamous (=1 if polygamous, 0 otherwise)	0.03	0.93	0.08	26.00***
Education (number of years schooling)	7.85	6.83	10.68	14.64***
Years lived in that location	11.00	13.34	10.34	-13.05***
Borrow money for medical fee (= 1 if yes, 0 otherwise)	1.70	1.03	1.69	-1.63*
Physically impaired (= 1 if yes, 0 otherwise)	0.06	0.03	0.15	12.57***
Food security (= 1 if yes, 0 otherwise)	0.48	0.47	0.48	1.28
Chronic illness (= 1 if yes, 0 otherwise)	0.05	0.07	0.05	10.31***
# of meals a day adults	2.55	2.56	2.55	0.94
# of meals a day kids	2.81	2.83	2.81	1.41*
Crop farming (= 1 if yes, 0 otherwise)	0.19	0.19	0.20	2.49***
Kept livestock (= 1 if yes, 0 otherwise)	0.37	0.37	0.37	6.47
Fishing (= 1 if yes, 0 otherwise)	0.01	0.01	0.01	-0.26
Food consumed from own farm	31.44	29.23	31.87	2.85***
Expenditure on food	1956.05	2813.50	1948.13	4.50***
Expenditure on preventive care	3.634	4.65	3.43	-0.73

***, **, and * indicates statistical significance at 1%, 5%, and 10% respectively.

Table 3 Probit Model Parameter Estimates for ganyu participation

Variables	Coefficient	Standard errors	P-value
Age (years)	0.019	0.006	0.020
Household size	-0.023	0.019	0.141
Education level	-0.248	0.033	0.000
Years lived in that location	-0.003	0.017	0.579
Monogamous	0.258	0.072	0.000
Polygamous	0.224	0.124	0.072
Male-headed household	0.305	0.067	0.000
Age squared	-0.002	0.000	0.025
Suffer chronic disease	-0.017	0.120	0.792
New born in last 24 months (yes/no)	-0.006	0.060	0.914
Crop farming (yes/no)	-0.085	0.065	0.313
Livestock farming (yes/no)	0.042	0.058	0.066
Disabled member (yes/no)	-0.040	0.102	0.651
Own land (yes/no)	-0.027	0.083	0.747
# of observations = 3785			LR chi2(13) = 121.950
Log-likelihood = -1993.92			P-value = 0.000

t statistics in parentheses; * P < 0.05, ** P < 0.01, *** P< 0.001

Table 4 Estimation of Average Marginal Effects by delta method

Variables	dy/dx	Delta method se	P-value
Age (years)	0.005	0.002	0.006
Household size	-0.007	0.003	0.019
Highest education level	-0.002	0.000	0.060
Years lived in that location	-0.001	0.001	0.165
Monogamous	0.077	0.021	0.000
Polygamous	0.067	0.037	0.072
Male-headed household	0.092	0.020	0.000
Age squared	-0.001	0.000	0.025
Suffer chronic disease (yes/no)	-0.005	0.030	0.792
New born in last 24 months (yes/no)	-0.010	0.015	0.493
Crop farming (yes/no)	-0.026	0.016	0.113
Livestock farming (yes/no)	0.012	0.014	0.376
Disabled member (yes/no)	-0.011	0.027	0.652
Own land (yes/no)	-0.008	0.025	0.747

Table 5 Average Treatment Effects of the Treated (ATET)

Variable	Number of matches(m)	ATET	Standard error	p-value
Total household income	1	944	1621	0.560
	2	1843	1468	0.209
	3	1228	1463	0.402
	4	1219	1443	0.398
	5	1328	1412	0.347
Total off-farm income	1	10580	4660	0.023
	2	8855	4183	0.034
	3	7006	4358	0.108
	4	6254	4295	0.145
	5	5180	4336	0.232
Total Farm income	1	-9702	5209	0.063
	2	-9431	4971	0.032
	3	-8690	4773	0.069
	4	-7172	4474	0.109
	5	-6848	4423	0.122
# of meals a day-kids	1	1.141	0.090	0.001
	2	1.423	0.095	0.050
	3	0.130	0.101	0.062
	4	0.231	0.100	0.069
	5	0.210	0.120	0.091
# of meals a day-adults	1	1.151	0.083	0.069
	2	1.112	0.066	0.092
	3	0.177	0.062	0.101
	4	0.065	0.061	0.186
	5	0.067	0.061	0.278
Consumption from own farm	1	-1.302	2.322	0.071
	2	-0.265	2.018	0.092
	3	-0.179	2.304	0.106
	4	-1.267	1.937	0.112
	5	-1.892	2.462	0.141
Money spend on Purchased food	1	66.622	76.661	0.056
	2	70.379	70.697	0.022
	3	79.690	70.308	0.102
	4	75.927	67.803	0.163
	5	70.712	66.195	0.282