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THE INITIAL LAND ENDOWMENTS AND LIVELIHOODS OF RURAL SMALLHOLDERS IN CENTRAL AND NORTHERN MOZAMBIQUE

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ABSTRACT

This study used two-year partial panel household surveys 2008-2011, to assess household income and poverty trends and their respective drivers, specifically to determining to what extent landholdings have influenced these changes in rural Northern-Central Mozambique. The study concludes that: i) No significant income change in total net household income, poverty level, and landholdings has been observed between the two survey years and ii) Landholdings have significant income effect on income but poverty, suggesting that the income gain resulting from the observed landholdings is not enough to generate sufficient income transition above the poverty line, and iii) welfare was found to have infrastructural, demographic, technological dimensions, the policy implications from this study include:1) developing and promoting agricultural technologies, rural financial services and microcredit, risk coping strategies through establishment development of drought resistant crop varieties to acelerate land expansion, 2) facilitating access to input and output markets through improving and expanding infrastructures, 3) promoting small and medium enterprises with vocational training programs in employable skills, and 4) providing public services (e.g. education and employment) and investing in physical infrastructures (roads and transports).

Keywords: landholdings, income, poverty, panel data, Mozambique

1. INTRODUCTION

Poverty, hunger, and malnutrition are three main constraints affecting the livelihoods of human beings. In developing countries these are important causes of child mortality; and governments in developing countries, such as Mozambique, have long struggled to defeat hunger (Garrett & Ruel, 1999). In the context of Mozambique, this situation is surprising as it contradicts the economic growth witnessed in Mozambique of GDP growth of more than 6.3 percent per year since 2006, resulting from government efforts in implementing a set of development programs

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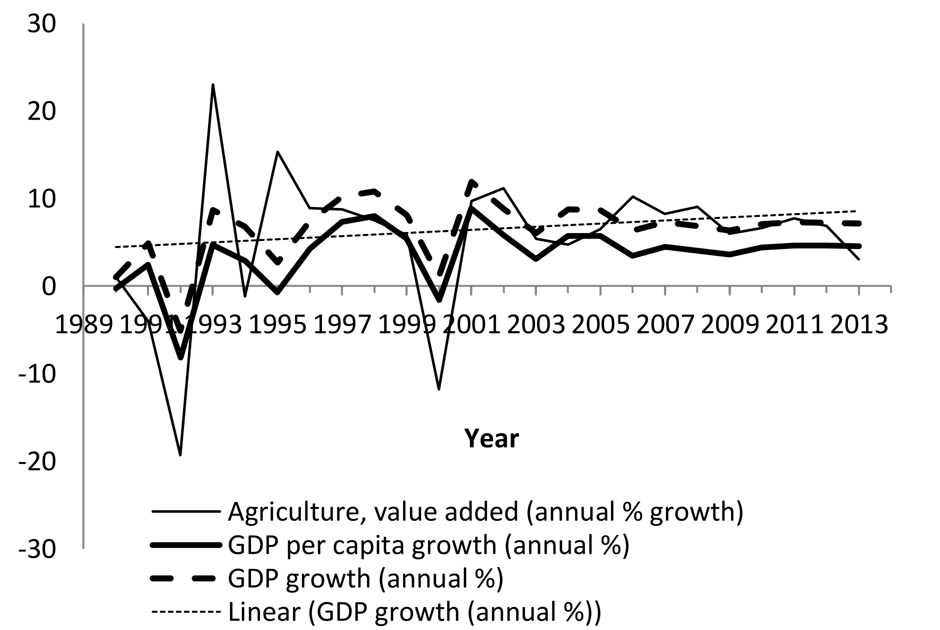
and policies including the National *Action Plan for the Reduction of Absolute Poverty*. The government of Mozambique has committed to reducing poverty from 70 percent in 1997 to 40 percent by 2015 (MINAG, 2010) through several interventions, including: the construction of silos with 50,000 metric ton capacity for grain storage in Tete province, improvement of infrastructure such as the building of the bridge across the Zambezi River which links the main production and consumption areas (Mabiso *et al*., 2014) and increasing agriculture production. All these interventions witness an impressive economic growth illustrated in Figure 1 and Table 1.

Figure 1: Growth rate of GDP, GDP per capita, and agricultural value added in Mozambique (1990-2013)



Source: World Development Indicators Databank (World Bank, 2014)

Despite these impressive growth figures, macroeconomic indicators show that poverty has not decreased, Mozambique was ranked 178th of 187 in the 2013 UNDP Human Development Index and 64th out of 78 on the 2013 Global Hunger Index (IFPRI, 2013; UNDP, 2014).

Lack of access to basic health, education, and sanitation services are the main factors exacerbating poverty in the country, in part due to budget misallocation in agriculture in benefit of other fast-growing sectors, such as the energy sector under the energy boom era. With the small-scale agriculture the primary source of livelihood for most rural households, accounting for a majority of the nation's agricultural production (85 percent) (Shapito *et al*., 2009), and that

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80 percent of the area under cultivation in Mozambique is used for rainfed production with limited use of improved inputs; efforts to increase production and productivity should be top priority in the government's development agenda. MINAG (2010) reported that despite the poor agricultural sector, the potential for increasing farm productivity is significant through extension services (about 8 percent) and that Mozambique's central and northern provinces have higher agricultural potential, including more fertile soils and more abundant rainfall than other parts of the country; these regions generally produce agricultural surpluses.

It is argued that the most prominent cause of poverty is the land scarcity (Burgess, 2001) and landholdings are poverty have close links. Therefore, land reform policies that encourage increased landholdings to low-income families are likely to generate positive impacts in reducing poverty. Gugerty & Timmer (1999) argue that an initial good distribution of assets, both agricultural and non-agricultural, benefits the poorest household slightly more in percentage terms, while in countries with inadequate initial asset distribution, the economic growth or well-being is skewed towards the wealthier families, causing a large gap between rich and poor.

Another perspective on this relationship is provided by Burgess (2001), who argues that land generates income but under imperfect food markets, land can serve as a source of cheaper food relative to market-purchased food. So, if the markets are imperfect like most of the times they are in developing countries, households with large farm size will still get cheaper food and consequently be less poor. Since in the African context farm size is one indication of wealth, increased landholdings will increase income and hence higher standard of living (quality of life) through (1) direct income value of additional production or rent out land if land is considered a liquid asset that can be sold or leased; (2) increased returns to family labor in the presence of labor market constraints; and (3) reduced vulnerability to shocks due to larger savings and enhanced insurance if land can be used as collateral.

Earlier studies in Sub-Saharan countries (Tschirley & Weber, 1994; Jayne *et al.,* 2003; Mather *et al*. (2012) found a strong correlation between food consumption, per capita income and landholdings and argue that landholding size would continue to be a key determinant of household income and welfare for the foreseeable future and due to its ability to lift the poorest households out of poverty. As such, these studies have recommended that the way out of poverty among the land-constrained households is either through increasing landholding size or engaging in off-farm income activities.

When all this dynamic is coupled with a decrease in the cultivated area per adult equivalent since 2005, understanding the income and poverty effect of cultivated land size has an important policy application as this can help estimate the impact of agricultural reform on poverty

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reduction among rural smallholders. The objective o this study is to tackle three main questions: (i) How has cultivated land size changed over time? (ii) How have livelihoods evolved over time? (iii) What drove those changes, specifically to what extent changes in cultivated land size influenced income and poverty changes? Finally, finding answers to the above questions will allow drawing policy implications to address poverty reduction in rural Mozambique.

2. DESCRIPTION OF DATA

The data for the analysis are drawn from a regionally repeat representative household agricultural survey conducted by the Mozambique Ministry of Agriculture to understand the investments needed to guarantee a robust response to the new rural environment resulting from the spike in food prices in the domestic and international markets. For that purpose, data covering the period before and after the food price crisis, in 2008 and 2011; respectively was collected. This survey was implemented with financial assistance from USAID/Mozambique and technical assistance from Michigan State University, and a total of 1,186 households were interviewed in the Central and Northern regions in the five provinces with high agricultural potential (Manica, Tete, Sofala, Nampula, and Zambezia). This type of data has the advantage of allowing controlling unobserved time-invariant household characteristics, which is one of the limitations of using cross-section data in empirical studies (Garrett & Ruel, 1999). Panel data have the advantage of allowing to gaining have an in-depth understanding of how the size of the landholdings, poverty, and dynamics in rural Mozambique and contribute to more efficient policy intervention design by controlling for unobserved time-invariant household characteristics.

Before delving into the estimation approach, some considerations need to be made concerning the data: First, although the panel is covering only 5 provinces out of 10 initially interviewed in 2008, it uses the weights of TIA[1]2008 because in 2011 there was no random replacement, implying that the sample is representative of 2008 population only. The TIA 2008 weights are used along with an attrition correction factor (Inverse Probability Weights) to control for the attrition bias. Two primary sources of attrition in 2011 were identified by the 2008-2011 panel data. First, the 2011 survey team did not go to all the TIA2008 districts in the center/north (due to financial reasons). Second, in the TIA2008 villages that were revisited in 2011, not all the households re-interviewed (due to refusal or unavailability of the respondents and because some families had moved or been dissolved). Tests for attrition have shown the evidence of the presence of attrition bias, and as proposed by Woodridge (2002), the appropriate inverse

[1] Is the household agricultural survey conducted by the Ministry of Agriculture locally known as "*Trabalho de Inquerito Agricola* "

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probability weights (IPW) were applied to the data. Donovan & Mather (2007) provide a detailed application of this method for Mozambican data using the panel data TIA2002 and TIA2005; a similar approach was followed in this study.

Out 72 districts sampled in 2008, a total of 42 districts were not re-visited in 2011 in Zambezia, Manica, Tete, and Sofala provinces. Therefore, the data is no longer representative at the provincial level, but remain representative of the areas surveyed in 2011. The Nampula province is the only one that did not drop a district between the two survey years; therefore, the data are representative at province level.

3. EMPIRICAL ESTIMATION

Panel data estimation is complicated due to the need to adjust the standard errors to account for the correlation between each period (Cameron and Trivedi, 2010). The most common estimation methods are the random- effects (RE), fixed-effects (FE), first-difference (FD), and pooled Ordinary Least Squares (POLS). The FE models permit the regressors to be correlated with random individual-specific effects, uncorrelated with the idiosyncratic errors and correlated with the time-invariant component of the random individual-specific effects; using an appropriate differencing transformation, this unobservable heterogeneity can be eliminated. The RE models, however, imposes a strong assumption that the random individual-specific effects are purely random, implying that they are uncorrelated with the regressors. POLS model assumes that regressors are exogenous, and the estimation is straightforward, but it requires controlling for correlation of error over time for a given individual or between individuals. However, no estimation method is free of limitations, like RE, the consistency of pooled models is conditional on the assumption of exogeneity. In any case, for inferences, we use cluster-robust standard errors.

While the FE is preferred in the empirical studies due to its properties, it appears inapropriate for this studies because the variable of interest is time-invariant which is dropped from the FE estimation, then the RE was chosen despite imposing a strong assumption about the correlation between the unobserved heterogeneity and the explanatory variables. Since the samples are drawn from a complex sampling strategy, cluster-specific differences may exist that cause per AE income to vary systematically across the cluster or villages, which lead to a violation of the assumption of the constant variance of the error term. Therefore, the robust standard errors are used to estimate the t-values. To address the research questions of this study, two types of models are estimated as described below.

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3.1 Household Income Model

In developing the empirical model to assess the effect of cultivated[2] land size on income, a log-log model is estimated, where the dependent variables is the natural log of income per adult equivalent[3] (AE) of the household total net income. Following previous studies (Walker *et al.*, 2004; Mather *et al.*, 2012), the total net household income is calculated using the full income approach consisting of: (1) valuing all crop production, regardless of whether it was for home consumption or sales, and cash inputs (hired labor, purchased seed, fertilizers, etc.) are deducted from the production and summed to (2) the value of non-agricultural income from various sources (salaries and wages, non-farm self-employment, retirement and other transfers, and rental of land or other assets).

Empirically, the relationship between household income and land size was implement by the following expression:

$$\ln Y_{it} = \beta_0 + \beta_1 Land_{it} + \beta_2 X_{it} + c_i + \mu_{it}; t = 1,...,T \qquad (1)$$

where $i=1, 2,.., N$. Here $\ln y_{it}$ is the log per AE income in real Meticais (in 2011 MZN) of household i, in year t. X is a vector of exogenous household-specific characteristics such as demographics, natural and physical endowments, human capital, technology, infrastructure, and village fixed-effect. $Land_{it}$ is the cultivated land size per AE (ha); ci is the unobserved heterogeneity. The coefficient β measures the return to a particular household resource on the percentage change in the per capita income across households, and the coefficient of interest is β_1. μ_{it} is the idiosyncratic error term assumed to be normal, independent and identically distributed with mean zero and constant variance.

3.2 Household Poverty Model

The evaluation of the poverty effect of cultivated land size is implemented in three main steps. First, for each year, the income model is estimated using the cross-section specification of equation 3 in OLS. Second, the fitted values from this estimation were used to generate the

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[2] Defined as all operated land under the households' rights or not, including all cropped land (permanent and annual crops, pasture, fallow land and land rented-in).

[3] Defined as a household index taking into account the consumption/production ability of the household based on Deaton (1997). The weights are based on gender and age (e.g. adults of either sex = 1.0, children aged 0-4 = 0.4, and children 5-14= 0.5).

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predicted poverty measures developed by Foster *et al.* (1984) in each period. The general expression for poverty measures of Foster *et al*. (1984)'s class is given by:

$$P_{\alpha} = \frac{1}{n}\sum_{i=1}^{q}(\frac{z-y_i}{z}) \qquad (2)$$

where *n* is the total population; *y* the predicted real income per AE; *z* the food consumption poverty line per AE ; q the number of households with predicted income per AE below the poverty line; and α≥0 is the "poverty aversion" indicator, such that as the parameter gets large more emphasis is given to the poorest poor. Three measures of poverty are considered to shed light on different aspects of poverty as reported in Table 2:

i. When α=0, P_0 is the head count ratio (HC), a measure of the incidence of poverty by estimating the percentage of people failing to meet the basic consumption requirements of household members.
ii. When α=1, is the poverty gap ratio (PG), measuring the depth of poverty by averaging the distance of per adult equivalent income of poor from the poverty line income as a percentage of the poverty line income for the entire population. This indicator measures how much would need to be transferred to bring poor's expenditure up to poverty line in the other words, the minimum cost of eliminating poverty.
iii. When α=2, is the measure of severity of poverty, in that gives greater weight to income shortfall, known as squared poverty gap (SPG). Essentially, this is a weighted sum of poverty gaps and considers the inequality among poor, such that the transfers from poor to less poor increase the index.

As Walker *et al.* (2004) and Jalan & Ravalion (1998) argue squared poverty gap is preferred as it provides information on the distance between income and poverty line as it satisfies two essential conditions (the convexity poverty function and the income transfer axiom) and that the head count index is a crude measure of poverty, to have an in-depth knowledge about poverty this paper uses the all three poverty measures (headcount, poverty gap, and squared poverty gap).

Third, we estimate three household poverty models as:

$$P_{\alpha it} = \beta_0 + \beta_1 Land_{it} + \beta_2 X_{it} + c_i + \mu_{it}, t = 1,...,T \qquad (3)$$

where $P\alpha_{it}$ is the poverty measures (for α=0 the $P\alpha_{it}$ is a dummy variable on the poverty status of the household with value of one assigned to poor and zero otherwise; for α=1 and α=2 the $P\alpha_{it}$ are continuous variables with non-poor assigned value of zero) of the household *i* in year t, $Land_i$ is the cultivated land size per AE in hectares, X_i a vector of other income drivers, *ci* the

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unobserved heterogeneity, and μ_{it} is the idiosyncratic error. The appropriate differencing technique is used to eliminate *ci*. To test the robustness of the empirical results, a different poverty line was used, the study used both local and international benchmark poverty line of $1.25/day (in 2005 PPP exchange rate). In this case, the poverty measures were estimated by comparing the income/capita to the $1.25/day PPP poverty line. These strategies were previously used in poverty analysis in Mozambique (Cunguara, 2008; Walker *et al*., 2004) using household survey data.

3.3 Income and Poverty covariates

The human capital is embodied in the members of the household and the ability to use this capital in the household size (Grootaert, 1997). As such, I hypothesized that the human capital has a significant and positive effect on income, which in turn reduces poverty. To capture the effect of human capital, the size of the family labor, education, gender and age of the head are included as covariates. It is expected that education contributes to earning potential and reducing poverty as found in previous studies elsewhere (Grootaert, 1997; Mukherjee & Benson, 2003; Achia *et al*., 2010; Geda *et al*., 2005; Okurut *et al*., 2002). The age of the head is included to capture the life cycle effect, and it has been found to have an inverse relationship with the probability of the household being poor, be negatively correlated to poverty reduction, and likely to be poor (Grootaert, 1997; Achia *et al*., 2010; Mukherjee & Benson,2003).

The household size can have both negative and positive effects depending on the composition of the household. The household size is included through the number of available family labor. But, in the context of Mozambique, where the dependency ratio is relatively high (many people in a household are not economically active), extended families may result in limited income generation ability, thus more likely to be poor. The gender of the household head is included to capture gender earning differences and it is expected that female-headed households are disadvantaged in both welfare measures (income and poverty). I hypothesize that female-headed households are more likely to be poor than male-headed households as found elsewhere by Geda *et al*. (2005). The civil status of the head is expected to have a significant effect on income and poverty as widowed households are supposed to have lower income and consequently more likely to be poor compared to their counterparts.

Variables to capture physical capital variation in rural Mozambique are also included in the models. The physical capital covariates included are productive assets such as the amount of cultivated land, land quality, and income sources, which are expected to be positively correlated with income because such productive physical capital makes a significant contribution to reducing poverty. Poverty literature reviewed indicates that asset variables such as land ownership were found to be correlated with poverty (see Grootaert, 1997). Soil quality is another productive asset included as a covariate in the models because good soil quality is associated with lower poverty and its coefficient is expected to be positive for income models and negative for poverty.

Previous research found raising livestock[4] as welfare gain strategies in Mozambique (Cunguara, 2008; Walker *et al*., 2004), therefore, similar effects are expected in this study, hence are included in the models. Given that livestock is used as a safety net in case of unexpected events, e.g. crop failure, funeral, or other unforeseen events that require additional expenses, then, a positive effect on income is expected.

Better access to infrastructure is believed to have a positive effect on income and poverty. Results from Okwi *et al*. (2007)'s study show that longer travel time to main roads increases poverty levels significantly. This is because the greater the travel time to a good road, the more costly it is and the more difficult it becomes to access markets, which reduces the livelihood options, leading to high poverty levels. Remoteness variable is included in this study to represent limited access to roads, general infrastructure, markets and other public services and consequently leading to lower income generating opportunities. The remote villages are defined as a binary variable taking a value of one if there are roads with limited travelability, lack public transportation services throughout the year, and zero otherwise.

Access to credit, technology adoption, extension services and non-farm income jobs are hypothesized to raise incomes, assuming that these services are available at the right time, quantity and quality. The agricultural technology adoption, measured by use of high-yielding varieties of the main staple foods along with chemical inputs are expected to increase income and reduce poverty as they increases crop production. Therefore, a positive effect on income and negative effect on poverty are expected.

4. RESULTS AND DISCUSSION

4.1 Descriptive Evidence

4.1.1 Structure and trend of rural household Income and Poverty

As reported in Table 1, the average annual net household income per adult equivalent at 2011 constant prices fell from 10,680 MZN in 2008 to 8,168 MZN in 2011. At the prevailing

[4] The total Tropical Livestock Units proposed by FAO (2008) was estimated using the following conversion rates are: Sheep and goat=0.10; Pig=0.25; Donkey=0.75; and poultry=0.01.

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exchange rate in 2011 from the Central National Bank (US$1=27.14 MZN), the household income slightly decreased from US$ 393 in 2008 to US$ 309 in 2011 in the study area. This trend was almost entirely on the account of farm income which dropped from US$ 229 in 2008 to US$ 146 in 2011. Note that farm income is by far the main income component of rural households in the study area contributing to more than 65 percent of the family income. As noted by Benfica *et al*. (2014), this trend could be associated with the fact that despite the presence of high or favorable price environment for output and increased market participation, increased production efficiency, there was an observed slow pace of intensification due to high input/output price ratio, making the intensification not profitable.

The poverty measure estimates show that in only three years, the incidence of poverty increased 8 percentage points, corresponding to an average of 2.7 percentage points per year between 2008 and 2011. The poverty increase was further strengthened by an increase in the severity of poverty by an average of 2 percentage points per year. Using the international poverty line of US$1.25 per capita per day based on parity purchase price (PPP), the poverty rate was much higher with similar trend although the difference between the two survey periods is not significant.

Table 1: Income, incidence, depth, and severity of income poverty, 2008-2011

Poverty	2008	2011	Total	% change	Signifi-cance
Total farm income (%)	*65.1*	*65.5*	*65.3*	0.6	
Total non-farm income (%)	*34.9*	*34.5*	*34.7*	-1.1	
Total Net income (in ‘000 2011 MZN)	10,7	8,2	9,4	-23.5	
Local poverty lines					
Head count index	0.32	0.40	0.36	3.0	**
Poverty gap ratio	0.23	0.29	0.26	1.0	**
Squared poverty gap	0.43	0.41	0.42	-1.0	
Poverty line =US$ 1.25/day based on 2011 Purchasing Power Parity (PPP)					
Head count index	0.78	0.80	0.79	2.0	
Poverty gap ratio	0.56	0.58	0.57	1.0	
Squared poverty gap	0.48	0.49	0.48	1.0	
Number of observations	1,172	1,172	2,344		

Significance level: * at 5%; ** at 1%

Source: Author’s computation from Partial Panel 2008-2011 Survey

These poverty estimates are below those by MPD (2010) using consumption indicator and local poverty lines of 54.7 percent in the entire country in 2008/09 and 49.6 and 56.9 percent in the Northern and Central Mozambique; respectively.

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4.1.2 Characteristics of sampled households

The 2008-2011 panel data allows us to understand better the short-term poverty dynamics over the three-year spell since 2008. The other features of the sample households are presented in Table 4. The average size of cultivated land per household did not increase over time, estimated at 2.59 ha in 2008 and 2.37 ha in 2011, mainly due to limited access to manpower and alternative power sources for land expansion (e.g. animal traction) (Mouzinho *et al*., 2014). The inherited land size accounts for about 52 percent of the cultivated land and followed the same pattern as the cultivated land size with no statistical change over time. Access to quality land observed 2.7 percentage points increase from 34 percent of sampled households that reported having the soil of high quality in 2008. The use of improved inputs is persistently low with the percentage of households using chemical fertilizer and pesticides estimated at 6 and 2.5 percent, respectively.

During the study period, a gradual shift of the rural occupational structure was observed accompanying the changing pattern of investment in physical and human capital. The number of households residing in non-remote areas found about 0.7 percent points increase and the number of migrant workers increased over this period.

Results in Table 2 show that the adoption of improved agricultural technologies is low in rural Mozambique and did not vary over time. For instance, the use of chemical fertilizer is estimated at 6 percent, while the adoption of pesticides is estimated at no more than 2.5 percent.

The structure of family labor occupation observed significant changes over time. Results show an increase in agricultural workers more than doubled in 2011 from an average of 2 in every 10 household members reported in 2008. The local and international migration rose from 2008 to 2011, with domestic migration increasing from 0.32 members per household to 0.64 members.

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Table 2: Characteristics of sample households, 2008-2011

Characteristics	Total		Year 2008 (1)		Year 2011 (2)		Operated land size/AE 08 quintiles		Mean differences	
	Mean	SD	Mean	SD	Mean	SD	Q1 (3)	Q5 (4)	1-2	3-4
HH lives in non-remote village (%)	41.0	49.2	40.7	49.1	41.4	49.3	44.6	34.1		*
Total land owned (ha)	2.94	3.74	3.09	4.06	2.79	3.35	1.58	5.83		**
Cultivated land size (ha)	2.48	3.41	2.59	3.79	2.37	2.95	1.16	5.10		**
Inherited land size (ha)	1.28	4.68	1.33	5.02	1.22	4.29	0.83	2.22		**
Female-headed household (%)	18.2	0.39	18.1	0.39	18.3	0.39	15.3	20.4		
Head's education (years completed)	3.1	2.96	3.1	2.97	3.1	2.95	3.7	2.6		**
Males in secondary school (number)	0.22	0.55	0.21	0.54	0.22	0.55	0.40	0.13		**
Head’s age (years)	42.1	13.28	42.3	13.32	41.9	13.24	43.5	41.5		
Widowed head (%)	7.4	0.26	7.6	0.26	7.2	0.26	5.2	7.2		
People aged 15-59 years (number)	2.6	1.36	2.7	1.35	2.6	1.37	3.4	2.2		**
People with self-employment (number)	0.69	0.92	0.74	1.01	0.65	0.80	0.80	0.58		**
HH size (Adult equivalent)	4.5	2.0	4.45	2.0	4.4	2.1	6.0	3.5		**
HH is food insecure (%)	24.3	0.43	25.6	0.44	23.0	0.42	25.7	15.4		**
Household has access to credit (%)	4.1	0.20	2.7	0.16	5.5	0.23	4.2	3.7		**
Household has good land quality (%)	35.3	0.48	34.0	0.47	36.7	0.48	51.4	19.5		**
Total Tropical Livestock units per household	0.94	2.72	0.98	2.93	0.91	2.47	1.11	1.01		
Household used fertilizer (%)	6.0	0.24	6.1	0.24	6.0	0.24	2.6	8.6		**
Household used pesticide (%)	2.5	0.16	2.6	0.16	2.4	0.15	0.0	4.9		**
Household used improved seeds for cereals	55.0	0.50	55.8	0.50	54.2	0.50	58.6	55.0		
Household used permanent labor (%)	4.9	0.22	4.7	0.21	5.1	0.22	5.7	4.7		
Household used animal traction (%)	11.6	0.32	12.7	0.33	10.5	0.31	9.1	15.8		*
Household hired seasonal labor (%)	28.3	0.45	27.0	0.44	29.7	0.46	30.1	23.8		
Number of agricultural workers	0.33	0.69	0.21	0.54	0.49	0.80	0.32	0.36	**	
Number of non-agricultural workers	0.13	0.34	0.11	0.33	0.14	0.35	0.10	0.11		
Number of domestic migrants per household	0.46	0.75	0.32	0.60	0.64	0.87	0.42	0.47	**	
Number of overseas migrants per household	0.02	0.14	0.00	0.03	0.04	0.19	0.02	0.02	**	
Number of observations	3,244		1,172		1,172					

Significance level: * at 5%; ** at 1%; SD is standard deviation

Source: Author’s computation from Partial Panel 2008-2011 Survey

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4.2 Empirical Results

4.2.1 Determinants of Household Income

Tables 3 and 4 (first column) present the parameter estimates for the marginal value of the family incomes. The empirical results highlight five key findings:

First, *ceteris paribus*, although no significant income change has been observed over time, confirming the descriptive statistics in Table 1, changes on cultivated land size/AE have a positive and significant effect on total income. The empirical results show that doubling the cultivated land size/AE lead to about 9 percent in total household income.

Second, the demographic characteristics of surveyed households such as availability of family labor, head's education, and age, have a significant welfare effect. Contrary to previous findings, the availability of household labor has a negative effect on income. Given the limited job opportunities in the rural areas, this result seems to suggest that 1) what matters is the proportion of family labor actually engaged in productivity activities not just the number of available family labor, 2) the cost differential between the family and hired labor makes rural households use hired labor instead of the available labor for their production, leaving the family labor to enjoy high return activities such investing in education and migrating to urban areas. As shown in Table 3, hired seasonal labor has a positive and significant welfare effect. Results also show that if the family labor can be used on self-employment activities it generates significant income for the family, therefore access to self-employment is an important livelihood strategy for rural households in rural Mozambique. Head's education was found to have a positive and meaningful impact on family income while income decreases significantly with head's age. The negative association between income and head's age highlights the importance of life cycle in income generation and erosion of income with time as no savings are made, which is a characteristic of poor rural families in Mozambique.

Third, livestock ownership is an important livelihood strategy as it serves as an informal family bank. Land quality is another important income driver. Results show that good land quality results in a 14 percent income increase compared to the poor land quality.

Fourth, access to public services such as credit and infrastructures has a positive and significant effect on income. Results show that access to credit does not lead to overall income gain, but it is a major factor in self-employment income, as households with access to credit have increased their self-employment up to about 76 percent while living in non-remote areas increase total net family income in 24 percent mostly due a 34 percent self-employment gain.

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Fifth, the results above are robust to the potential endogeneity bias on cultivated land. Although the land market is thin in rural Mozambique, treating land as exogenous would depend on intergenerational land transfers and unobserved characteristics that determine land access and household income. The consistent estimates are reported in the first column on Table 4.

4.2.2 Determinants of Income Poverty

The estimated parameters of determinants of poverty using the three most commonly used poverty measures are presented in Table 3 and Table 4 (from second column). In the second and fifth columns, head count index models are estimated in a dichotomous variable Probit model with poor households assigned a value of one and non-poor a value of zero. The third and fifth and columns pertain to income poverty severity[5], the poverty gap while the fourth and seventh the squared poverty gap models; respectively. The independent variables are the same as those used in the income regression models.

Given that a value of one in the head count index is assigned to poor households, higher value in the severity measures indexes high severity, the negative signs of coefficients imply a reduction of poverty and positive signs of coefficients reveal an increase in poverty. As expected, many of the variables explaining variation in household income also account for the change in poverty, although with an opposite sign. Results indicate that keeping other factors constant, from 2008 to 2011, the incidence of poverty, the severity, and the squared poverty gap rose significantly by 7.7, 7.7, and 9.4 percentage points; respectively under the local poverty lines only (a year of high food prices). These results are consistent with the descriptive statistics in Table 1, highlighting the worsening of poverty in rural Mozambique between the two study years.

The determinants of poverty in Mozambique have been well documented (Datt et al., 2000; Jayne *et al.,* 2003; Walker *et al*., 2004; Boughton *et al.,* 2005; Boughton *et al.,* 2006; Cunguara, 2008; MPD, 2010) using a variety of available nationally representative data. A common finding in those studies is the positive effect of the size of cultivated land/AE in reducing poverty. To some extent, results in Table 3 and Table 4 confirm the welfare effect of cultivated land size but not necessarily on poverty reduction. The lack of poverty reduction effect of cultivated land could be explained by the fact that the average farm size in rural Mozambique is very small and

[5] Note that these are aggregated population level indicators. Although poverty estimates are individual rather than household status, for empirical analysis the estimates were calculated at household level accounting for their composition given that the survey data was collected at household level rather than at individual level. To avoid, to make rather strong that that individuals enjoy the same level of welfare and accounting for the potential intra-household inequality, the total household income was conversion into AE and compared to the local poverty lines also converted to AE.

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is stagnant. The cultivated land size does not have a significant effect on reducing income poverty although it increases the total net household income significantly, suggesting that creating conditions that encourage land expansion and utilization is likely to lead to poverty reduction if sufficient income gain is observed. However, in the short-run, as is the time horizon of this study, the trend is encouraging.

It is noteworthy that the results are sensitive to the poverty line and assumption about exogeneity of the operated land size. While under local poverty lines and exogenous assumption of operated no statistical effect is found on poverty, the contrary is observed when higher poverty lines are used and endogenous land allocation is assumed. Under these conditions, increasing operated land size leads to both income gain and poverty reduction.

Since the transition to above the poverty line is discrete, a significant income gain is needed to lift people out of poverty. Given that changes in the size of cultivated land/AE are very limited in rural Mozambique, the results of this paper echo the findings by Jayne *et al*. (2003) on the need to guarantee initial distribution of assets including land as essential for pro-poor growth and poverty reduction in developing countries. However, increasing cultivated land/AE requires complementary services and assets, suggesting coordinated interventions not isolated and sporadic initiates.

Similar to income, poverty is found to have asset, infrastructural, and demographic dimensions in rural Northern-Central Mozambique as reported in Table 3 and Table 4. Access to public transportation and good roads throughout the year is likely to decrease incidence, poverty gap and poverty gap square by 9.8, 9.7, and 14.5 percentage points and a much higher impact is observed when operated land allocation is assumed to be endogenous. With same trend, an additional household member with access to self-employment reduces the poverty incidence by 16.3 percent under local poverty lines when the cultivated land is set as endogenous. Similar results were found elsewhere in Africa, for instance, Dercon *et al*., (2009) found that access to all-weather roads reduces poverty by about 7 percentage points while increasing consumption growth by about 16 percentage points. Under local poverty lines, using and improved seeds increase the chance of reducing incidence of poverty, poverty gap and poverty gap square by about 8.9, 9.0, and 13.1 percentage points; respectively.

Surprisingly, education, gender, age, and access to credit were found to have no significant effect on poverty reduction although the head’s education increases income while it decreases with head’s age.

Again, consistent with earlier discussion, the size of family labor availability has a negative effect on poverty reduction. Especially, when high poverty line is used.

Table 3: Determinants of household income, incidence and severity of income poverty at local poverty lines

Variables	RE models				RE-IV models			
	Income	HC	PG	SPG	Income	HC	PG	SPG
Year=2011	-0.018	0.076**	0.077**	0.092**	-0.001	0.240**	0.240**	0.094**
	(-0.35)	(4.26)	(4.27)	(3.48)	(-0.02)	(3.22)	(3.22)	(2.69)
HH lives in non-remote village (1=Yes)	0.239**	-0.079**	-0.079**	-0.111**	0.251**	-0.310**	-0.310**	-0.129**
	(3.37)	(-3.60)	(-3.63)	(-3.40)	(3.35)	(-3.74)	(-3.74)	(-3.26)
Log of cultivated land per AE	0.090*	-0.007	-0.008	-0.003	0.660**	0.138	0.138	0.065
	(2.17)	(-0.53)	(-0.63)	(-0.14)	(2.80)	(0.87)	(0.87)	(0.95)
Male-headed HH (1=Yes)	0.103	-0.039	-0.038	-0.073	0.060	-0.321*	-0.321*	-0.145*
	(0.81)	(-1.09)	(-1.09)	(-1.52)	(0.49)	(-2.38)	(-2.38)	(-2.56)
Head's education (Years completed)	0.029*	-0.007	-0.007	-0.009	0.029*	-0.015	-0.015	-0.003
	(2.11)	(-1.67)	(-1.63)	(-1.51)	(1.99)	(-0.89)	(-0.89)	(-0.47)
Males in secondary school (Number)	0.013	0.002	0.002	-0.002	0.019	0.036	0.036	0.016
	(0.17)	(0.07)	(0.10)	(-0.05)	(0.27)	(0.41)	(0.41)	(0.42)
Head's age (Years)	-0.010**	0.002*	0.002*	0.003*	-0.007*	0.007*	0.007*	0.003*
	(-3.20)	(2.46)	(2.40)	(2.47)	(-2.11)	(2.07)	(2.07)	(2.39)
Widowed head (1=Yes)	0.146	-0.026	-0.026	-0.028	0.067	-0.429*	-0.429*	-0.156*
	(0.80)	(-0.55)	(-0.56)	(-0.44)	(0.41)	(-2.42)	(-2.42)	(-2.01)
People aged 15-59 years (Number)	-0.169**	-0.009	-0.009	-0.014	-0.056	-0.031	-0.031	-0.016
	(-6.01)	(-0.94)	(-0.93)	(-1.13)	(-1.01)	(-0.65)	(-0.65)	(-0.79)
People with self-employment (Number)	0.133**	-0.040**	-0.043**	-0.074**	0.162**	-0.151**	-0.151**	-0.082**
	(4.11)	(-2.92)	(-3.06)	(-3.94)	(4.31)	(-2.74)	(-2.74)	(-3.43)
HH have access to credit (1=Yes)	0.019	-0.001	0.002	0.016	0.102	0.042	0.042	0.077
	(0.13)	(-0.01)	(0.03)	(0.21)	(0.61)	(0.20)	(0.20)	(0.76)
HH has good land quality (1=Yes)	0.147*	-0.030	-0.031	-0.044	0.326**	-0.110	-0.110	-0.050
	(2.36)	(-1.40)	(-1.47)	(-1.43)	(3.36)	(-1.06)	(-1.06)	(-1.11)
HH used fertilizer (1=Yes)	0.282*	-0.096*	-0.095*	-0.159*	0.138	-0.270	-0.270	-0.130
	(2.24)	(-2.02)	(-1.99)	(-2.26)	(0.82)	(-1.49)	(-1.49)	(-1.68)
HH used improved seeds (1=Yes)	0.282**	-0.085**	-0.087**	-0.136**	0.234**	-0.172	-0.172	-0.078
	(4.40)	(-4.03)	(-4.09)	(-4.43)	(2.91)	(-1.73)	(-1.73)	(-1.72)
HH used permanent labor (1=Yes)	0.058	-0.026	-0.027	-0.070	0.075	-0.005	-0.005	-0.052
	(0.42)	(-0.54)	(-0.54)	(-0.93)	(0.47)	(-0.02)	(-0.02)	(-0.61)
HH hired seasonal labor (1=Yes)	0.248**	-0.063**	-0.064**	-0.088*	0.255**	-0.257*	-0.257*	-0.094*
	(3.46)	(-2.65)	(-2.64)	(-2.54)	(2.94)	(-2.42)	(-2.42)	(-2.02)
HH used animal traction (1=Yes)	0.055	0.021	0.022	-0.013	-0.012	-0.018	-0.018	-0.014
	(0.50)	(0.65)	(0.67)	(-0.25)	(-0.10)	(-0.13)	(-0.13)	(-0.23)
Total Tropical Livestock units per HH	0.020	-0.006	-0.007	-0.010	0.028*	-0.018	-0.018	-0.009
	(1.61)	(-1.42)	(-1.50)	(-1.53)	(2.15)	(-1.06)	(-1.06)	(-1.22)
Constant	8.487**			-0.145	8.433**			-0.025
	(33.78)			(-1.39)	(32.96)			(-0.20)
Observations	2003	2003	2003	2003	2003	1970	1970	1970
R-Square	0.141				0.095			

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Wald chi2-statistic	328.0	127.7	121.5	175.7		137.5	137.5	159.4
Wald p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-statistic					4.966			
p-value of F-statistic					0.000			
Sargan-Hansen statistic					9.891			
p-value of Sargan-Hansen statistic					0.1948			
Wald test of exogeneity (corr = 0)						0.470	0.470	0.580
p-value of Wald test						0.493	0.493	0.446
rho	0.365			0.240	0.275			

Marginal effects; *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$

HC=Head count; PG=Poverty gap; PSG=Poverty gap square

Source: Author's computation from TIA 2008 and Partial Panel 2011

Table 4: Determinants of household income, incidence and severity of income poverty at $1.25/day PPP poverty line.

Variables	RE models			RE- IV models		
	HC	PG	SPG	HC	PG	SPG
Year=2011	0.018	0.018	0.015	0.053	0.053	0.016
	(1.17)	(1.19)	(0.96)	(0.74)	(0.74)	(0.56)
HH lives in non-remote village (1=Yes)	-0.004	-0.004	-0.054**	-0.106	-0.106	-0.089**
	(-0.22)	(-0.18)	(-2.63)	(-1.29)	(-1.29)	(-2.99)
Log of cultivated land per AE	-0.034**	-0.034**	-0.042**	-0.877**	-0.877**	-0.344**
	(-3.03)	(-3.05)	(-3.56)	(-7.69)	(-7.69)	(-6.59)
Male-headed HH (1=Yes)	0.002	0.002	-0.028	0.000	0.000	-0.011
	(0.05)	(0.05)	(-0.82)	(.)	(.)	(-0.19)
Head's education (Years completed)	-0.005	-0.005	-0.009*	-0.008	-0.008	-0.005
	(-1.36)	(-1.37)	(-2.22)	(-0.54)	(-0.54)	(-0.89)
Males in secondary school (Number)	-0.009	-0.009	-0.001	-0.053	-0.053	-0.008
	(-0.43)	(-0.44)	(-0.07)	(-0.70)	(-0.70)	(-0.28)
HeadÓ³ age (Years)	0.001	0.001	0.002*	0.001	0.001	0.001
	(0.95)	(0.94)	(2.14)	(0.39)	(0.39)	(0.87)
Widowed head (1=Yes)	-0.040	-0.040	-0.058	-0.140	-0.140	-0.067
	(-0.88)	(-0.87)	(-1.29)	(-0.92)	(-0.92)	(-1.00)
People aged 15-59 years (Number)	0.034**	0.034**	0.042**	-0.075	-0.075	-0.031*
	(4.04)	(3.97)	(5.30)	(-1.57)	(-1.57)	(-2.08)
People with self-employment (Number)	-0.035**	-0.035**	-0.043**	-0.143**	-0.143**	-0.072**
	(-3.49)	(-3.46)	(-4.14)	(-3.09)	(-3.09)	(-3.96)
HH have access to credit (1=Yes)	-0.034	-0.034	-0.033	-0.279	-0.279	-0.114
	(-0.79)	(-0.78)	(-0.71)	(-1.52)	(-1.52)	(-1.63)
HH has good land quality (1=Yes)	-0.015	-0.015	-0.024	-0.378**	-0.378**	-0.154**
	(-0.83)	(-0.83)	(-1.27)	(-4.21)	(-4.21)	(-4.17)
HH used fertilizer (1=Yes)	-0.079*	-0.077*	-0.071	-0.040	-0.040	-0.012
	(-2.02)	(-1.99)	(-1.62)	(-0.25)	(-0.25)	(-0.20)

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HH used improved seeds (1=Yes)	-0.038*	-0.038*	-0.071**	0.011	0.011	-0.026
	(-2.04)	(-2.06)	(-3.70)	(0.11)	(0.11)	(-0.69)
HH used permanent labor (1=Yes)	0.029	0.031	0.007	0.118	0.118	0.018
	(0.69)	(0.72)	(0.17)	(0.70)	(0.70)	(0.27)
HH hired seasonal labor (1=Yes)	-0.058**	-0.058**	-0.069**	-0.217*	-0.217*	-0.100**
	(-2.89)	(-2.89)	(-3.26)	(-2.28)	(-2.28)	(-2.69)
HH used animal traction (1=Yes)	0.001	0.001	-0.004	0.112	0.112	0.033
	(0.05)	(0.03)	(-0.14)	(0.92)	(0.92)	(0.66)
Total Tropical Livestock units per HH	-0.007*	-0.007	-0.007	-0.025	-0.025	-0.010
	(-1.98)	(-1.90)	(-1.78)	(-1.63)	(-1.63)	(-1.59)
Constant			0.267**			0.235*
			(3.68)			(2.36)
Observations	1982	1982	2003	1949	1949	1970
Wald chi2-statistic	107.1	102.7	223.1	269.5	269.58	217.6
Wald p-value	0.000	0.000	0.000	0.000	0.000	0.000
Wald test of exogeneity (corr = 0)				33.728	33.728	41.195
p-value of Wald test				0.000	0.000	0.000
rho	0.561	0.539	0.403			

Marginal effects; *t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$
HC=Head count; PG=Poverty gap; PSG=Poverty gap square
Source: Author's computation from TIA 2008 and Partial Panel 2011

4.3 Conclusions

The key findings regarding the effect of the size of cultivated land/AE on income and poverty are as follows.

No significant income change in total net household income and the size of cultivated land/AE has been observed between the two survey years.

The size of cultivated land per AE was found to increase income, but, not the incidence of poverty when land allocations decisions are assumed to be exogenous. When land allocation decisions are assumed endogenous, significant poverty reduction is found when international poverty line is used.

The availability of family labor does not have a direct effect on income per se, but what matters is the composition of the family, mainly the number of members with access to self-employment. This suggests that the family labor availability is not of value if it is not used in productive activities, which are limited in rural Mozambique. Therefore, promoting income generating opportunities to rural families is recommended, especially, self-employment opportunities with proper training.

Investing in infrastructures of transport such as public transportation and roads is more likely to have a positive in agricultural growth and poverty reduction. This study shows that families living in remote areas are worse-off compared to their counterparts living in accessible villages.

Regarding agricultural technologies, the study concludes that the use improved seeds and hiring seasonal labor for agricultural production have a significant effect in increasing incomes and reducing poverty, yet the coverage of extension services is still limited.

The policy implications from this study include: promoting agricultural technologies, rural financial services, risk coping strategies through establishment development of drought resistant crop varieties; small and medium enterprises for self-employment, vocational training programs in employable skills, facilitating access to input and output markets through improving and expanding infrastructures, promoting and implementing land reforms to ensure that the cash-constrained households have access to land, providing public services (e.g. education and employment), and investing in physical infrastructures (roads and transports).

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