This is to certify that the
thesis entitled

PATHWAYS OUT OF POVERTY IN RURAL MOZAMBIQUE

presented by

BENEDITO ARMANDO CUNGUARA

has been accepted towards fulfillment
of the requirements for the

Master of Science degree in Agricultural Economics

Major Professor's Signature

July 21, 2008

Date

PATHWAYS OUT OF POVERTY IN RURAL MOZAMBIQUE

By

Benedito Armando Cunguara

A THESIS

Submitted to
Michigan State University
In partial fulfillment of the requirements
For the degree of

MASTER OF SCIENCE

Department of Agricultural Economics

2008

ABSTRACT

PATHWAYS OUT OF POVERTY IN RURAL MOZAMBIQUE

By

Benedito Armando Cunguara

This research addresses three questions: (i) how have the incidence of poverty and the distribution of income changed? (ii) what factors are associated with rural household income change? and (iii) what factors are associated with moving out of or into poverty in the short-run? The analysis presented is based on a nationally representative two-period panel data set from Mozambique, covering the years 2001/2 and 2004/5. We cannot unambiguously argue that poverty headcount in 2005 (a year of more widespread drought) was higher than poverty headcount in 2002, but the poverty gap and squared poverty gap measures were both higher in the second period. Poverty has spatial, demographic, and asset holding dimensions. The diversification of off-farm income sources is strongly associated with increases in household income, and thus poverty reduction. For agricultural activities, especially crop production, reduction in vulnerability to drought is important for poverty reduction. Access to price information is positively correlated with income and poverty reduction in all areas, and the cultivation of tobacco is also significant in reducing poverty in the central part of the country. The impact on poverty of growing tobacco or cotton in the north was not significant, however. We also found that increases in landholding size can reduce poverty in rural Mozambique but will require additional inputs such as labor, fertilizers, and animal traction.

DEDICATION

To my dad, for his encouragement in pursuing graduate studies.

To my son, for his sacrifice during the two years of graduate studies.

To my wife, for her love, sacrifice, and support in everything.

To my mom and brothers, for their support and love.

ACKNOWLEDGMENTS

The author would like to acknowledge the financial support from USAID and the Ministry of Agriculture in Mozambique for making possible the realization of the National Agricultural Survey, commonly known as TIA. Ellen Payongayong and the staff from the Departments of Statistics and Policy Analysis within the Directorate of Economics of the Ministry of Agriculture have done a great job in cleaning and organizing the data. The author is also indebted to the households who participated on the surveys.

For comments on various drafts, the author would like to acknowledge but not implicate David Mather, Duncan Boughton, Tom Walker, David Tschirley, Eric Crawford, Charles Ballard, Cynthia Donovan, Gilead Mlay, Deborah Mulcahey, and Peter Ollila.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

AE	Adult Equivalent
CBN	Cost of Basic Needs
CDF	Cumulative Density Function
FEI	Food Energy Intake
FEWSNET	Famine Early Warning System Network
FGT	Foster-Greer-Thorbecke
GDP	Gross Domestic Product
HH	Household(s)
IAF	Household Survey of Living Conditions (Inquérito aos Agregados Familiares Sobre as Condições de Vida)
IFPRI	International Food Policy Research Institute
IIA	Independence of Irrelevant Alternatives
INE	National Statistics Institute (Instituto Nacional de Estatística)
IPW	Inverse Probability Weights
MNL	Multinomial Logit Regression
MNP	Multinomial Probit Regression
MPF	Ministry of Finance and Planning
MTn	Meticais da Nova Família
OLS	Ordinary Least Squares
PRSP	Poverty Reduction Strategy Paper
PSU	Primary Sampling Unit
RRR	Relative Risk Ratios
SAT	Semi-arid Tropics
SIMA	Agricultural Markets Information System
TIA	National Agricultural Survey (Trabalho de Inquerito Agricola)
UEM	Eduardo Mondlane University
USAID	United States Agency for International Development

CHAPTER I INTRODUCTION

Mozambique's economy is characterized by limited diversification and high dependency on the agricultural sector, which accounts for a quarter of the Gross Domestic Product (GDP). Per capita GDP is estimated to be $345, and more than half the population live in poverty[1] (Government of Mozambique, 2006). In addition, 89 percent of the population is involved in agriculture, including a significant segment of the urban population (Government of Mozambique, 2001). Poverty incidence is higher in rural areas, making the study of the factors associated with rural income and potential policy interventions important.

If major pathways out of poverty were identified empirically, policy interventions could be designed to facilitate escape from poverty, and to avoid others from falling into poverty. One of the reasons for the dearth of such studies is the lack of panel data, particularly from developing countries. This paper exploits a unique nationally representative two-period panel data set from rural Mozambique covering the years 2002 and 2005, and seeks to analyze the patterns of poverty exits and avoidance of falling into poverty, by examining the processes of socio-economic mobility among rural households.

The motivation for analysis of poverty dynamics is that some poor households may need a different type of help through policy than others. Policy research needs to distinguish between transitory and chronic poverty. Policies that can effectively block the descent of

[1] Poverty incidence is based on official poverty lines from the National Institute of Statistics in Mozambique, derived from consumption expenditure data.

the transient poor into chronic poverty may be different from but complementary to those to help the chronically poor find a way out of poverty. The selection of the right set of policies depends on an accurate understanding of the underlying factors associated with rural poverty dynamics.

A major strength of this paper derives from the unique features of the data. Although the data only cover a relatively short period of time (three years), panel data provide the opportunity to deepen the understanding of factors associated with transitory and chronic poverty, and therefore to design more effective policy interventions.

This paper presents one of the first empirical studies of poverty dynamics in Mozambique. So far the available studies on factors associated with rural income in Mozambique have based their empirical analysis on cross sectional data sets. Moreover, the poverty literature on Mozambique has not given much attention to the mechanisms to avoid households from falling into poverty, because poverty dynamics research requires panel data and the 2004/5 Trabalho de Inquérito Agricola (*TIA05*) is the first household panel in Mozambique. The present study addresses these gaps by analyzing the factors associated with income change and movements out of or into poverty.

1.1. RESEARCH AND POLICY QUESTIONS

The Mozambican government's five-year plan for the period 2005-2009, commonly known as PRSP II (Poverty Reduction Strategy Paper II) sets as its main objective the reduction of absolute poverty levels (Government of Mozambique, 2006). Government

policies and reforms, together with substantial donor support, have contributed to macroeconomic stability, rapid growth, socio-economic transformation and poverty reduction. Economic growth has been driven in part by consistent growth in the agricultural sector, despite unfavorable climatic conditions in 2000 and 2005 (Government of Mozambique, 2006). This study aims to understand both the factors associated with income change and the driving factors that enable rural households to climb out of poverty and to avoid falling into poverty.

Despite the significant reduction in poverty incidence in the late 1990's, more than 60 percent of the rural population still lives in poverty (MPF/UEM/IFPRI, 2004). Furthermore, one aspect that has not been given much attention in the current poverty literature on Mozambique is the fact that a considerable number of households may be moving into poverty, even though overall poverty rates have been decreasing. Reducing poverty both through lifting poor households out of poverty, especially in rural areas, and preventing the non-poor from falling into poverty, remains an important development challenge for Mozambique.

Though poverty reduction depends on the magnitude of economic growth, the distribution of the benefits of growth also matters. Poverty reduction will be larger if the benefits of growth go more to the poor than to the non-poor. Thus, when studying determinants of rural households' income change, it also becomes important to address the question of how the income distribution and inequality have changed.

This study will address three questions: (i) how have poverty measures, income distribution and inequality changed? (ii) what factors are associated with rural household income change? and (iii) what factors are associated with moving out of or into poverty in the short-run? Finally, some policy implications will be drawn from the findings from the above questions.

The following section reviews the current poverty literature. Chapter two describes the data used, followed by a descriptive analysis of poverty and income dynamics in chapter three. Chapter four presents the regression methods and results which provide the basis for the policy simulation presented at the end of chapter four. Chapter five summarizes key findings from the descriptive and regression analysis, and provides some policy recommendations.

1.2. LITERATURE REVIEW

An extensive literature on poverty dynamics has been devoted to the sensitivity of results to important methodological decisions such as the choice of the welfare measure (Slesnick, 1993; Chaudhuri and Ravallion, 1994; Lipton and Ravallion, 1995), distinguishing transitory from chronic poverty (Duclos *et al.*, 2006; Hulme, 2003; Jalan and Ravallion, 1998), and the choice of the poverty line (Tarp *et al.*, 2002; Booysen *et al.*, 2005; Ravallion and Lokshin, 2003; Arndt and Simler, 2007).

This section discusses these methodological issues. It starts with a discussion of choice of welfare measure, followed by the choice of poverty line. Then, the distinction between

transitory and chronic poverty is presented, followed by a discussion of the poverty analysis methods found in the literature. A discussion of the potential advantages and limitations of panel data is followed by a brief review of related studies in Mozambique.

1.2.1. WELFARE MEASURE

In a money-metric approach to measuring poverty, various authors argue that there are theoretical reasons why consumption is believed to be more accurate than income as the welfare measure. First, in panel data covering shorter periods (or in cross-section data), the transitory income component becomes very important, making the probability of misclassifying households as poor (or non-poor) higher (Gradin *et al.*, 2004).

Second, when using income as the welfare measure, the assumption is that a market exists for all goods, which is not the case in many developing countries (Thorbecke, 2005). Also, there is no guarantee that households with income at or even above the poverty line would actually allocate their incomes so as to purchase the minimum basic-needs bundle.

Third, rural incomes fluctuate in response to the agricultural year, especially in a rural economy which is dominated by rainfed crop production. In rural Mozambique, crop income accounted for 73 percent of total household income in 2002, with a 95 percent confidence interval from 70 to 75 percent. In 2005 crop income accounted for 65 percent of total household income, with drought being the likely main cause of reduction of crop income share in the latter period.

Fourth, income is more likely to be underreported than consumption expenditure (Alderman, 1992). In sum, the general consensus among economists (based on both theory and observation) is that household consumption varies less over time than does income, and that consumption is therefore the preferred welfare indicator (since it represents actual consumption obtained by the household, whereas income represents a measure of potential consumption).

Nonetheless, as Walker *et al.* (2004) pointed out, when the research objective is to analyze the determinants of rural poverty and their implications for agricultural development, the analysis of data on consumption expenditure may not lead to specific, actionable conclusions. Data on the relevant agricultural variables may be missing, incomplete, or variation in data on consumption expenditure may be relatively small and more difficult to explain. This paper uses household income per adult equivalent[2] as the welfare measure, given the policy questions addressed.

1.2.2. THE CHOICE OF POVERTY LINES

The choice of poverty line is another important methodological decision for researchers. A common definition of the poverty line is the minimum income/consumption level below which a person is considered to lack adequate subsistence. Poverty rates will be influenced by the poverty line that one chooses to use. The literature on poverty lines

---

[2] To calculate the adult equivalent units in a given household, adults of either sex receive a weight of 1.0, children aged 0-4 receive a weight of 0.4, and children 5-14 receive a weight of 0.5 (Deaton 1997).

identifies four major methods of setting the poverty lines: the Food Energy Intake (FEI) approach, the Cost of Basic Needs (CBN) approach, the one-dollar-a-day criterion often used for international comparisons, and a social subjective poverty line (Tarp *et al.*, 2002). The main desirable characteristics of a poverty line are its consistency and specificity. Consistency is related to making equal classification for people with the same living standard, whereas specificity is associated with its applicability to the communities under consideration. Since poverty lines are important in poverty dynamics studies, it is essential to perform some sensitivity tests to changes in poverty lines in order to assess the robustness of the poverty measures[3].

Arndt and Simler (2007) argue that the CBN approach provides more credible results in the case of Mozambique, and they use this approach to construct the *IAF* (Household Survey of Living Conditions) expenditure-based per capita poverty lines for 1996/97 and 2002/03 (MPF/UEM/IFPRI, 2004). However, per capita poverty lines fail to reflect the needs of household members, as children and adults are given the same weight. An alternative is to adjust the poverty lines taking into account both the household size and composition. Fox *et al.* (2005) presents poverty lines per adult equivalent. These poverty lines are based on the value of a basket of basic-need goods consumed by the poor in 2002, and they differ by region, reflecting regional consumption patterns and price variations.

[3] Poverty lines will be varied upward and downward by 20 % when running the Multinomial Logit models presented in Chapter 4.

The present paper only uses the food component of the poverty lines, calculated by Fox *et al.* (2005). For a country as poor as Mozambique, a poverty line that is based on the intake of food to reach a recommended caloric dietary allowance is likely to be meaningful marker of rural welfare (Walker *et al.,* 2006), since food represents such a large part of rural expenditure. For each region, the food poverty line is constructed by determining the food energy intake requirements for the reference population (the poor), the caloric content of the typical diet of the poor, and the average cost (at local prices) of a calorie when consuming that diet. The food poverty line is calculated as the product of the average daily calorie requirement per adult equivalent and the average price per calorie.

Poverty lines were inflated to 2004/05 prices, using *IAF02* consumption quantities from the consumption basket for each poverty region. The baskets from 2002 were revalued using *SIMA* (Portuguese acronym for Agricultural Market Information Systems) prices from 2002. Then the cost of an identical consumption basket was computed using *SIMA* prices from 2005, and hence, the consumption quantities are the weights for the prices[4]. Table 1 presents the poverty lines by province and year. Poverty lines vary considerably among provinces, with the province of Sofala having the lowest poverty line in 2005. The inflators constructed to update the poverty lines show no price inflation in Sofala and Tete. The reason for this is that the *SIMA* price of both maize grain and flour fell in rural markets of these provinces from 2002 to 2005, and maize grain and flour account for 50 percent of the food basket in Sofala and 60 percent in Tete (Mather *et al.*, forthcoming).

[4] Details of the construction of the inflator by Mather *et al.* (forthcoming) are found in appendix A1.

Table 1. Food consumption expenditure poverty lines per adult equivalent by province

Province	Food poverty line per adult equivalent		
	Meticais (MTN)/year		US $/year
	2002	2005	2005
Niassa	2660	3309	135
Cabo Delgado	2660	3492	143
Nampula	2179	2965	121
Zambézia	2048	2254	92
Tete	2736	2564	105
Manica	2736	2920	119
Sofala	2048	2014	82
Inhambane	3240	4568	186
Gaza	3240	4415	180
Maputo Prov.	5619	7136	291

Sources: Exchange rate is $1.00 US = 24.50 MTN (Unofficial - July 2005); Official poverty lines from National Statistic Institute (INE)

1.2.3. DISTINCTION BETWEEN TRANSITORY AND CHRONIC POVERTY

Another methodological issue that researchers have to deal with is how to distinguish transitory from chronic poverty. The distinguishing feature of chronic poverty is its extended duration. Though a two-period three-year panel is much better than a single cross-section, it is still somewhat limited in allowing us to distinguish chronic from transitory poverty (i.e., a five- to six-year panel would be preferable).

An alternative approach to identifying the non-stochastic component of income change is to use the predicted household income per adult equivalent from a regression model that captures the relationship between a household's income and its characteristics, in order to purge the influence of idiosyncratic (household-specific) transitory shocks (McKay and Lawson, 2002). Thus, predicted income more closely approximates longer-term or expected household income than actual income. This paper uses predicted household

income values to group households into four mutually exclusive poverty status categories: (i) stayed poor in both periods; (ii) moved out of poverty; (iii) moved into poverty; and (iv) stayed non-poor in both periods.

One possible way to distinguish between transitory and chronic poverty is as follows. Households moving out of poverty whose predicted income and asset holdings in the second period exceed the median predicted income and assets holdings of those staying non-poor could be considered to have escaped poverty. Landholding size per adult equivalent was used as a proxy to compare asset holdings of households staying non-poor and those escaping poverty, because it is the most common asset among rural households, unlike livestock ownership which varies considerably by province. Table 16 in chapter three presents the proportion of households who meet these criteria, though it is not possible to validate it with a two-period panel.

1.2.4. POVERTY ANALYSIS METHODS

A number of different approaches have been adopted to understand the factors associated with chronic and transitory poverty, or with poverty transitions. Most studies complement descriptive analysis with an explicitly multivariate approach, generally based on econometric analysis. Econometric studies generally take two forms: (i) those modeling a discrete dependent variable measuring dynamic poverty status, and (ii) those modeling the (generally continuous) underlying variable measuring the welfare. The continuous approach can be estimated using either the fixed-effect model or the first-difference model, whereas the discrete approach is usually modeled as a multinomial logit model.

Various authors argue that the aggregation of a continuous variable into a discrete one has the disadvantage of loss of information (Ravallion, 1996). Discrete poverty outcome models such as multinomial logit regressions are also criticized due to the fact that the choice of poverty line is arbitrary and the assumption regarding the Independence of Irrelevant Alternatives (IIA) may not always be valid. However, the multinomial logit model presents three advantages over the continuous regression approach. First, it may be the case that variables that determine whether one occupies a position in the top, middle, or bottom of the distribution are likely to differ (Trzcinski and Randolph, 1991). Second, when studying income mobility, one could argue that small position changes are negligible, and income changes become important only when the change is large enough to make the household cross a decile or even quintile threshold (Verpoorten, 2003). Third, a multinomial logit model can take into account the presence of nonlinearity in a more flexible way, and estimate differential effects across the distinct categories of losers and winners compared to a reference category.

In turn, to avoid both the loss of information and the issue of which poverty line to use, economists usually take a continuous dependent variable approach to understanding the determinants of household income change. Fixed-effect and first-difference models have been explored by various authors to analyze factors associated with changes in poverty and inequality (El-laithy *et al.*, 2003; Datt and Jolliffe, 2005; Grootaert *et al.*, 1995). First-difference models correct for bias in the estimated coefficients due to endogeneity caused by omitted variable bias. They may also capture the effect of initial household

characteristics. Also, the first-difference model is often used in an attempt to reduce multicollinearity problems (Resnick and Birner, 2006). When the panel data only cover two-period observations, the fixed-effect and the first-difference model estimates and all test statistics are identical (Wooldridge, 2002a).

In sum, depending on the research question addressed, the researcher can either use the continuous or the discrete approach. The multinomial logit regression is used in this paper to address the question regarding the factors associated with moving out of or into poverty, whereas the first-difference model is used to evaluate the determinants of income change. The next section discusses the problem of attrition bias in panel data, followed by a brief review of poverty research in Mozambique highlighting some of the gaps in these studies.

1.2.5. ATTRITION BIAS

Panel data can provide a more accurate inference of model parameters. Hsiao (2005) argues that panel data usually contain more degrees of freedom and less multicollinearity than cross-sectional data; hence it improves the efficiency of econometric estimates. Panel data also provide greater capacity for capturing the complexity of human behavior than a single cross-section or time-series data set (Hsiao, 2005; Maluccio, 2000). For instance, consider the example provided by Hsiao (2005) regarding the evaluation of the effectiveness of social programs. Evaluating the effectiveness of certain programs using a cross-sectional sample typically suffers from the fact that the ex-ante household characteristics of those receiving treatment are different from those not receiving

treatment. Panel data has the advantage that it is possible to observe the before- and after-effects of receiving the treatment for the same individual unit of observation, as well as providing the possibility of isolating the effects of treatment from other factors affecting the outcome.

A potential limitation of panel data is attrition bias in the household sample. Attrition bias occurs when the probability of an observation not being revisited is non-random with respect to observed or unobserved household characteristics. One must correct for panel data attrition in order to obtain unbiased estimates. The use of Inverse Probability Weights (IPW) has been proposed by Wooldridge (2002b) to address the issue of attrition bias. In short, IPW will effectively minimize attrition bias if the observed characteristics of the household are useful in predicting whether a household will be re-interviewed, and unobserved characteristics are not strong predictors. Mather and Donovan (forthcoming) provide an IPW correction factor for the data used in this study, based on their analysis of prime-age adult mortality and poverty in Mozambique.

1.2.6. RELATED STUDIES IN MOZAMBIQUE

Datt and colleagues (2000) analyze the determinants of poverty in Mozambique, using data from the consumption expenditure survey, *IAF96*. Though this was a very detailed study, it failed to provide actionable recommendations regarding the agricultural sector. Walker *et al.* (2004) using rural household income data from the National Agricultural Survey, *TIA02*, have also analyzed the determinants of rural income and poverty in Mozambique. The latter study was able to propose policy interventions specifically

related to agriculture, which supports the use of income data as the welfare measure when the research question is to evaluate the determinants of rural poverty in Mozambique.

In their article on the determinants of household income and consumption in rural Mozambique, Tschirley and Weber (1994) found that incomes and calorie consumption were highly correlated with landholdings, and argued that landholding size would continue to be a key determinant of household income and consumption for the foreseeable future. In line with these findings, Jayne *et al.* (2003) also found a positive association between landholding size and per capita income in several African countries (including Mozambique), and acknowledged the importance of the initial distribution of assets to the rate of economic growth and poverty reduction efforts.

Jayne *et al.* (2003) argue that under existing conditions, the ability of households in the bottom per capita land quartile to escape from poverty directly through agricultural productivity growth is limited by their constrained access to land and other resources. An important recommendation drawn from their study is that the way out of poverty among the land-constrained households is either to increase landholding size, or to have these households pulled into productive rural off-farm and non-farm sectors. In Mozambique, however, the distribution of wage income tend to be concentrated among higher income households, both in absolute value and as a share of total income, and the reasons for this pattern are structural in nature and thus not easily addressed in the short-run (Tschirley and Benfica, 2001). The same authors suggested rural formal education as the most obvious lever to increase the access of the poor to salaried income.

The role of landholding size in reducing poverty is also documented in Boughton *et al.* (2005) and Boughton *et al.* (2006). Stagnant crop productivity and limited area expansion appear to be key constraints to achieving more favorable distributional outcomes. While various studies have pointed out the importance of landholding size to poverty reduction efforts, the average farm size in Mozambique is still very low[5].

In terms of inequality, James *et al.* (2006) found that all sections of society enjoyed a rapid annual increase in consumption between 1996 and 2002, but the rate of growth in consumption was slightly higher for richer households, which led to a moderate increase in inequality at national level. Boughton *et al.* (2005) also found that growth in household income was concentrated among the wealthier households. There is also evidence on inequality regarding access to land (Jayne *et al.*, 2001; Marrule 1998) and off-farm opportunities (Tschirley and Benfica, 2001).

While the findings from these studies on the determinants of income and poverty mentioned above are very informative, they have some limitations. Studies based on cross-sectional data sets may suffer from a key econometric problem, which is the omitted variable (or unobserved heterogeneity) bias, which can be reduced when using panel data. For example, as Maluccio (2000) pointed out, rarely do surveys observe or measure a family's preferences and priorities for educating its children. It is quite likely that families that put a high priority on education will perform additional work to obtain

[5] The average landholding size in 2002 was 1.7 hectares, with a 95 percent confidence interval between 1.6 and 1.8 hectares.

income needed to pay school fees. The same author argues that if we use cross-sectional data alone to determine the effect of family income on education, we risk making incorrect inferences, as families with the highest income may also be those that prioritize education the most. This paper uses panel data, allowing us to control for unobserved time-invariant household characteristics.

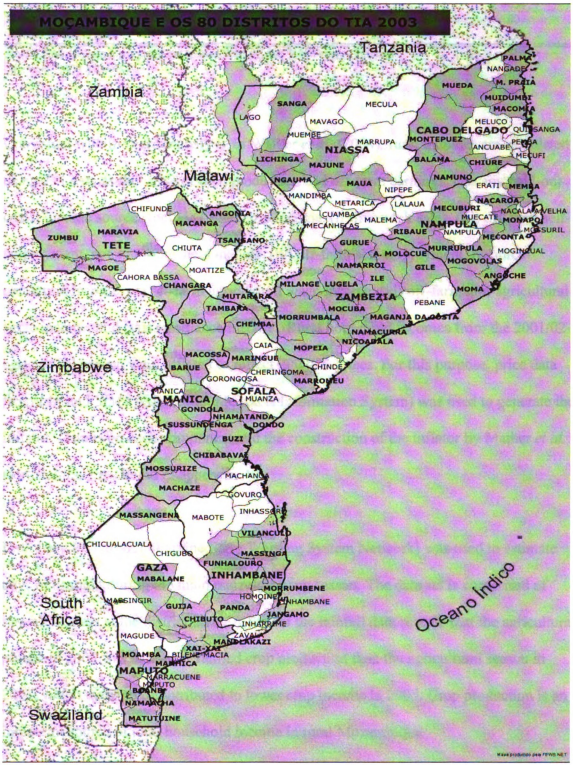
None of the available studies has empirically made the distinction between those moving into and out of poverty, which is one of the focuses of this paper. Though national poverty rates have decreased, available studies are unable to identify whether there are households that suffer from chronic poverty. If appropriate policy action depends on whether poverty is chronic or transitory, then it becomes crucial to make this distinction. Little is known about the factors that can be explored to help the non-poor avoid falling into poverty. The use of panel data provides the opportunity to deepen the understanding of poverty dynamics in Mozambique and design more effective policy interventions. This study addresses the gaps from previous studies by controlling for unobserved time-invariant household characteristics and distinguishing the factors associated with moving out of and into poverty, using the recently collected panel data set on rural household income in Mozambique.

CHAPTER II DATA SOURCES

The National Agricultural Survey of 2005, commonly known as *TIA05*, was implemented by the Department of Statistics within the Directorate of Economics of the Ministry of Agriculture in 2005, for the agricultural season 2004/2005, covering the period from September 2004 to August 2005. The sampling frame was developed from the Census of Agriculture and Livestock of 2000. The sample was stratified by province and agro-ecological zone. Figure 1 shows the distribution sampled districts in 2003 which are the same as those for *TIA02*. An additional 14 districts were included for *TIA05*. In terms of agricultural potential, the central and northern provinces are more favorable to crop production, whereas the drier southern provinces are more favorable to livestock production.

The *TIA05* survey represents the first effort to collect a nationally representative panel data set in rural Mozambique. It covered 94 out of 128 districts (Table 2). Data on small and medium-sized farms were complemented by group interviews at the community level, field measurements, and a separate questionnaire for all large-sized farms. A total of 4054 households were re-interviewed in 2005. Of the original *TIA02* sample, about 850 households could not be interviewed in 2005 due to various reasons, migration being the most common. Only panel households are used in the analysis because poverty dynamics studies require data from the same households across time.

Figure 1. Distribution of TIA sampled districts in 2003



Source: FEWSNET

Table 2. National Agricultural Survey sample sizes

	TIA02	TIA05	Panel
Households interviewed	4908	6149	4054
Number of districts	80	94	80
Primary sampling units	559	656	556

Notes: TIA02 covers the agricultural season 2001/02 and TIA05 covers 2004/05
Sources: TIA02 & TIA05

Consistent with the earlier analysis of Walker *et al.* (2004), rural incomes are calculated using *TIA* data as the value of own production and off-farm earnings, less any paid-out costs. Income sources include (i) net crop income, (ii) livestock sales, (iii) off-farm self-employment, net small-business income, (iv) off-farm self employment, resource-extraction income, (v) off-farm agricultural wage income, (vi) off-farm non-agricultural wage income, and (vii) remittance income. Rural household incomes from the 2001/02 agricultural season were inflated to reflect 2004/05 prices. For this purpose, price data from *IAF* and *SIMA* (Agricultural Markets Information System) was used to generate the inflator. Details on each component and the construction of the inflator by Mather *et al.* (forthcoming) are found in appendix A1.

Data from FEWSNET (Famine Early Warning System Network) was used to estimate days of drought during the main maize-growing season. The data set is comprised of rainfall records at the district level. A look at the rainfall data reveals that the agricultural season in 2005 was worse for rainfed crop production than the agricultural season in 2002, which may have contributed to lower crop income in 2005. Crop production is an important source of total household income in rural Mozambique.

CHAPTER III DESCRIPTIVE ANALYSIS

This chapter covers the descriptive methods and results. Poverty is analyzed by province and with respect to key household characteristics and other factors that may affect rural household income in Mozambique. Inequality and income distribution changes are also assessed. The next chapter will present regression methods and results.

3.1. POVERTY MEASURES

This paper uses the popular Foster-Greer-Thorbecke (FGT) measures of poverty, which for a given population are defined as

$$(1) \quad P_\alpha = \frac{1}{N} \sum_{i=1}^{q} \left(\frac{z - y_i}{z}\right)^\alpha$$

where α is the poverty aversion parameter,

N is the sample size,

y_i is the predicted (from OLS regressions) household income per adult equivalent,

z is the food consumption expenditure poverty line per adult equivalent (AE), and

q is the number of households with predicted income/AE below the poverty line.

Three poverty measures are calculated based on three values of α. The headcount index of poverty measures the proportion of households below the poverty line, i.e., the incidence of poverty. When $\alpha=0$ equation 1 is reduced to

$$(2) \quad P_0 = \frac{q}{N}$$

Poverty incidence from both years is then used to classify the households into four mutually exclusive categories based on predicted household income per adult equivalent: (i) moved out of poverty, (ii) moved into poverty, (iii) stayed poor, and (iv) stayed non-poor (Figure 2). These groups will be used as the dependent variable in the multinomial logit regression (MNL) model, and they are defined as follows:

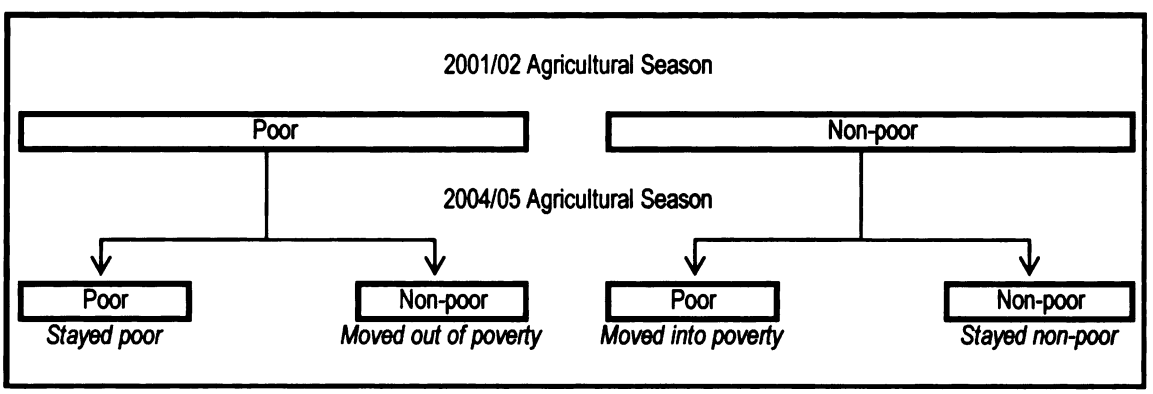
Moved out of poverty: if $y_{i1} < z$ but $y_{i2} > z$

Moved into poverty: if $y_{i1} > z$ but $y_{i2} < z$

Stayed poor: if $y_{it} < z$ for all t

Stayed non-poor: if $y_{it} > z$ for all t

Figure 2. Poverty categories based on predicted incomes



The headcount index fails to capture the distance that individual income falls below the poverty line (Jha and Sharma, 2003). Therefore, a second measure of poverty was used, with $\alpha=1$. The poverty gap index is given by the aggregate income shortfall of the poor as a proportion of the poverty line and normalized by the population size (equation 3).

$$(3) \quad P_1 = \frac{1}{N} \sum_{i=1}^{q} \left(\frac{z - y_i}{z}\right)$$

The poverty gap index captures the intensity of poverty. To put it differently, the poverty gap measures the total amount of income required to remove that poverty. Kakwani (1980) pointed out two main drawbacks associated with this index: (i) it is completely insensitive to the number of poor, and (ii) it does not take into account the inequality among the poor.

A third measure of poverty, the squared poverty gap, is obtained when $\alpha=2$. It measures the severity of poverty and is given by:

$$(4) \quad P_2 = \frac{1}{N} \sum_{i=1}^{q} \left(\frac{z - y_i}{z}\right)^2$$

By squaring the poverty gap for each household, this measure gives greater weight to those that fall far below the poverty line than those that are closer to it.

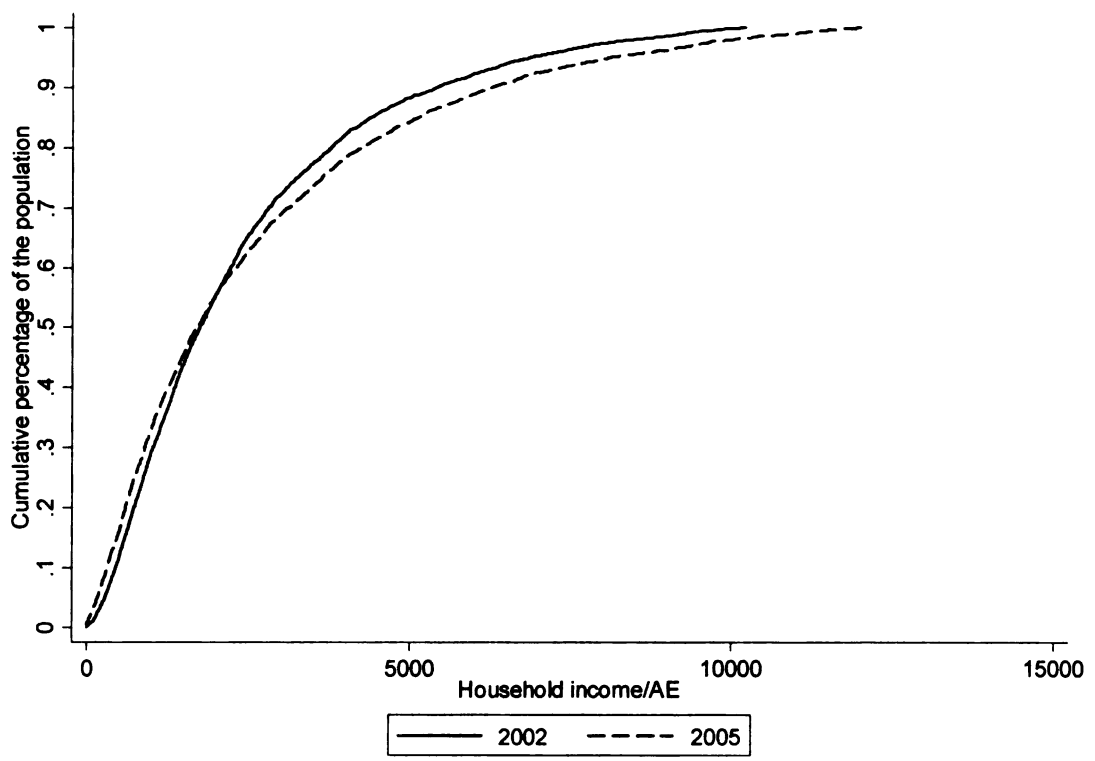
3.2. STOCHASTIC DOMINANCE ANALYSIS

The choice of the poverty line is often discussed in the literature as one of the key decisions to make when comparing welfare between two periods. If first-order dominance is achieved, the implication is that poverty incidence is unambiguously lower in one period than in another, regardless of the poverty line that is used. Consequently, it is appropriate to evaluate the robustness of our conclusions with regard to different poverty

lines, which we will do using the concept of stochastic dominance as applied in the poverty analysis literature (Ravallion, 1992).

Stochastic dominance refers to a set of relations that may hold when comparing a pair of distributions. For instance, given the distributions of rural household income per AE in Mozambique in 2002 and 2005, one can evaluate whether the distribution in the latter period dominates the distribution from the first period by plotting both cumulative distributions in the same graph. Figure 3 shows that the first-order stochastic dominance does not hold since the cumulative distributions intersect[6].

Figure 3. First-order stochastic dominance



[6] Figure 3 excludes the top 5% from each year.

The first-order stochastic dominance test corresponds to a comparison of poverty incidence (head count) between the two periods. Thus, we cannot unambiguously say that poverty incidence in one period is lower (or higher) than in the other period. Since the first-order stochastic dominance was not achieved, we can test for second- and third-order stochastic dominance, which correspond to the poverty gap and squared poverty gap measures respectively. Also, if necessary, one can go on to test higher-order dominance, though the interpretation of these measures becomes less clear (Ravallion, 1992).

A rough approximation to second- and third-order stochastic dominance would be to calculate poverty gap and squared poverty gap for each province for 2002 and 2005 and determine whether these poverty measures have declined or risen for all provinces. This comparison would reflect only a single set of provincial poverty lines. Alternatively, one could repeat the comparison for a range of different provincial poverty lines.

Table 3 shows that poverty incidence at the national level increased by almost 1 percentage point between 2002 and 2005. However, sensitivity analysis indicates that this finding is not robust to the poverty line that is used. By increasing poverty lines we find that poverty incidence is higher in the first period. In contrast, by decreasing poverty lines we find that poverty incidence is lower in the first period. In line with findings from Figure 3, first-order stochastic dominance was not achieved since using a different poverty line we rank the distributions differently. In other words, within the range of

poverty lines presented in Table 3, poverty incidence at the national level did not change unambiguously between the two periods.

Table 3. Poverty incidence by province and year with different poverty lines

	Actual poverty line		Decrease poverty line by 20%		Decrease poverty line by 50%		Increase poverty line by 20%		Increase poverty line by 50%	
Province	2002	2005	2002	2005	2002	2005	2002	2005	2002	2005
Niassa	82.6	79.0	73.6	67.9	34.1	38.0	88.7	87.1	94.6	92.0
Cabo Delgado	94.3	82.2	87.9	70.5	56.5	43.8	98.0	88.0	99.5	92.6
Nampula	79.9	88.4	64.2	81.7	27.3	56.2	89.2	93.3	93.1	96.9
Zambézia	81.0	87.7	69.7	82.3	39.7	51.4	86.7	91.6	92.7	95.5
Tete	72.9	81.3	64.9	75.6	41.2	57.1	79.4	84.3	86.4	90.1
Manica	84.1	84.9	78.1	73.6	54.2	54.0	89.6	87.3	91.8	92.4
Sofala	81.9	55.4	70.3	45.8	45.4	18.6	88.4	63.1	94.9	73.9
Inhambane	82.1	80.4	76.1	66.9	43.1	38.8	90.9	88.3	96.2	92.7
Gaza	95.2	92.5	91.6	84.6	71.0	58.3	96.4	94.9	97.5	97.9
Maputo	89.8	93.8	85.7	89.7	63.1	70.7	92.8	94.8	95.9	97.5
National	83.2	84.1	73.4	76.0	43.0	49.6	89.4	88.9	93.8	93.4

Source: TIA02 & TIA05

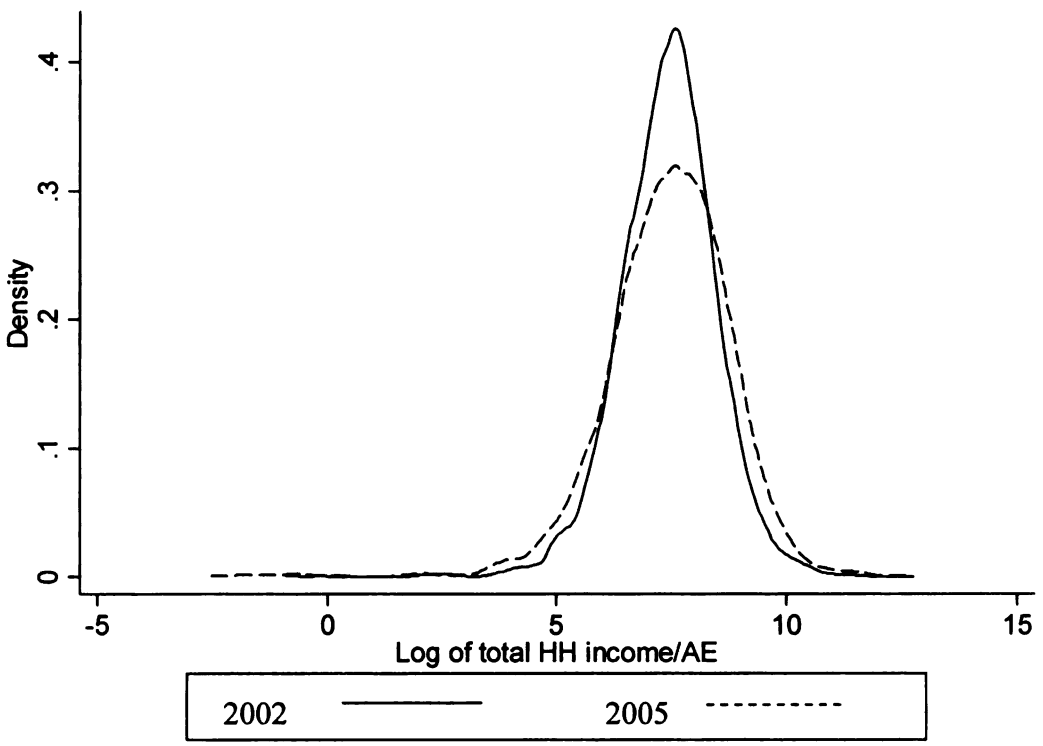
At the provincial level, we can unambiguously say that poverty incidence has decreased (or increased) for some provinces. For instance, regardless of the poverty line that is used, poverty incidence in the provinces of Cabo Delgado, Sofala, and Inhambane is lower in the second period, whereas for Nampula and Zambézia provinces poverty incidence is higher in the second period regardless of which poverty line is used.

Within the range of poverty lines used, the depth and severity of poverty at the national level were worse in 2005 than in 2002. Poverty gap and squared poverty gap increased significantly in Nampula and Zambézia, regardless of the poverty line that one chooses to use. Poverty depth and severity have significantly decreased in Sofala, regardless of the poverty line that is used. Results of poverty gap and severity are presented in the appendix (Tables A1 and A2).

3.3. INCOME MOBILITY AND INEQUALITY

Figure 4 shows household income distributions in 2002 and 2005. Ideally we would want the entire distribution to shift to the right. The distribution in the latter period has become more spread. The fact that the tails of the distribution are longer in 2005 reveals that the poorest households have decreased their incomes, and the wealthiest households have increased their incomes. This pattern is also observed in Table 4, which presents mean and median household income by quintile and gender of household head.

Figure 4. Household income distribution per AE in 2002 and 2005



At the national level, mean household income/AE has significantly increased from 2002 to 2005 at the 0.05 level. In contrast, median income/AE has decreased, as most of the increase in household income accrued to those household among the highest income quintiles. Both the mean and median household incomes have decreased among the two

lowest income quintiles. Moreover, male-headed households have significantly higher income levels than female-headed households in both periods.

Table 4. Mean and median household income per AE by quintiles and head's gender

		Mean (Meticais)		Median (Meticais)	
		2002	2005	2002	2005
Household income quintiles/AE in each year	Lowest	494	376	469	351
	2	1,086	986	1,027	901
	3	1,792	1,822	1,736	1,669
	4	2,941	3,310	2,728	2,960
	Highest	8,221	10,243	5,673	6,753
Gender of household head	Female	2,189	2,590	1,359	1,389
	Male	3,136	3,634	1,877	1,848
National		2,906	3,348	1,751	1,708

Sources: TIA02 and TIA05

The income transition matrix helps understand the pattern of income change over time. It shows what fraction of households belonging to a given base-period income group end up in a given final-period income. If all the households had remained in the same income quintile, then the transition matrix would be an identity matrix and the diagonal elements would sum to 100 percent, reflecting the absence of any income mobility. Table 5 shows the household transition matrix from 2002 to 2005. From those that were in the lowest household income quintile/AE in 2002, about 12 percent have moved to the highest quintile in 2005. This result indicates that the poor are not necessarily doomed to remain at the bottom.

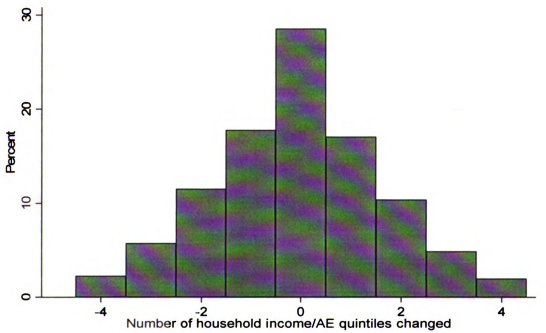
Table 5. Transition matrix of household income quintiles per AE by year

		Household income quintiles per AE, 2005					Total
		Lowest	2	3	4	Highest	%
		%					
	Lowest	30.8	25.2	19.6	12.9	11.6	100
Household	2	25.7	21.8	20.5	18.9	13.0	100
income quintiles	3	19.1	20.4	21.6	22.3	16.6	100
per AE, 2002	4	12.9	20.3	19.6	24.7	22.5	100
	Highest	11.4	12.5	18.7	20.9	36.5	100
Total		100	100	100	100	100	100

Sources: TIA02 and TIA05

Figure 5 illustrates quintile movements between the two periods. Households moving four quintiles backward were located in the highest household income/AE quintile in 2002 but belong to the lowest income/AE quintile in 2005. Likewise, households switching four quintiles forward are those that were the poorest in 2002, but are now among the wealthiest. About one quarter of the households remained in the same quintile.

Figure 5. Number of household income per AE quintiles changed



The fact that the mean income has decreased among the lowest income quintiles suggests an increase in inequality. One of the common ways of evaluating changes in inequality between two periods is to use Lorenz curves. The Lorenz curve plots the percentage of total income earned by various portions of population when the population is ordered by the size of their incomes. If Lorenz curves intersect, then it is not possible to make an unambiguous ranking. Inequality increases with increases in the distance between the Lorenz curve and the 45° line.

The Gini coefficient is bounded between 0 and 1, the upper bound corresponding to the highest inequality. While not without limitations this coefficient is widely used in poverty literature for purposes of comparison. Table 6 presents Gini coefficients and percentile ratios for each year. Gini coefficients are obtained from reported household income/AE. The Gini coefficient increased from 0.54 to 0.60, which is very high compared to other countries in Africa[7].

Table 6. Percentile ratios of household income/AE and Gini coefficient by year

Percentile ratio	Ratio of reported household income/AE	
	2002	2005
Percentile ratio P90/P10	19.33	22.26
Percentile ratio P90/P50	3.24	4.69
Percentile ratio P10/P50	0.17	0.21
Percentile ratio P75/P25	4.34	5.18
Percentile ratio P75/P50	1.96	2.19
Percentile ratio P25/P50	0.45	0.42
Gini coefficient	0.54	0.60

Sources: TIA02 & TIA05

[7] Using adult equivalent units, Simkins (2004) estimated the Gini coefficient for South Africa to be 0.64. South Africa is considered to be among the most unequal in the world (World Bank, 2006). In the late 1990s, Gini coefficients for rural Ghana, Zambia and Zimbabwe were 0.37, 0.48 and 0.57, respectively (Christiaensen *et al.* 2002).

Percentile ratios are also useful in analyzing inequality. They summarize the relative distance between two points on the income distribution. To illustrate the full spread of the income distribution, the percentile ratio needs to refer to points near the extremes of the distribution. The P90/P10 ratio in Table 6, for example, shows that the ratio between the wealthiest and the poorest households' income has increased. The P75/P25 ratio better illustrates the magnitude of the range within which the incomes of the majority of the population fall. The P75/P50 and P25/P50 ratios focus on comparing the ends of the income distribution with the midpoint.

Figure 6 shows graphically that inequality has indeed increased between the two periods. The ratio of the area between the Lorenz curve and the line of absolute equality (the diagonal) to the area underneath the diagonal is the Gini coefficient in Table 6.

Figure 6. Lorenz curves at national level using reported income in 2002 and 2005

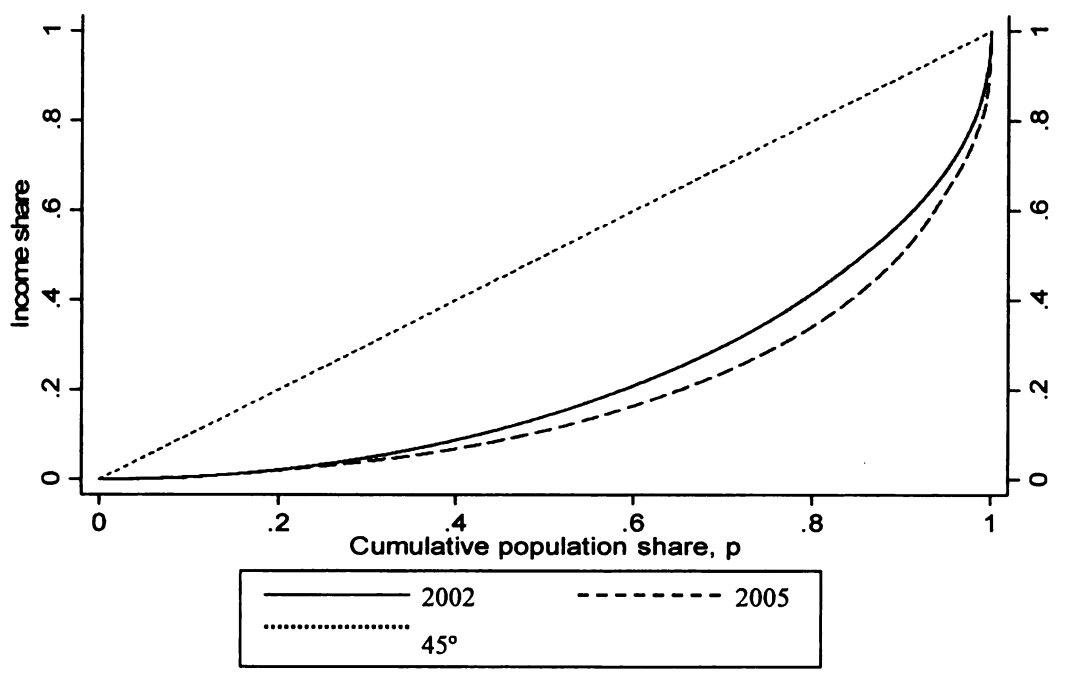


Table 7 provides the distributional summary statistics by income quintile. At the bottom of the distribution, the maximum household income/AE is about 617 MTn (Meticais) in 2002, and 647 MTn in 2005, which corresponds to 37 percent of the median income/AE in 2002, and 39 percent in 2005, respectively. Despite the slight increase, the ratio of the income share between the top income quintile and the poorest quintile is 27 in 2002 but 32 in 2005, indicating that increases in household income were faster among the wealthiest households. In addition, the maximum household income/AE in each income quintile is about twice the maximum household income/AE in the immediate lower quintile.

Table 7. Distributional summary statistics using reported incomes, 2002 - 2005

Income	Maximum HH Income/AE in each quintile		% of the median		% Share of All Income	
Quintile/AE	2002	2005	2002	2005	2002	2005
1	617	647	36.5	39.4	2.2	2.0
2	1290	1169	76.3	71.3	6.7	4.9
3	2189	2207	129.5	134.5	12.1	9.6
4	3968	4409	234.8	268.8	20.7	17.8
5	NA	NA	NA	NA	58.4	65.8

NA: The first 4 cells in of the last row in Table 7 are blank because those cells would correspond to the maximum household income/AE in our sample, and comparing these values with the median is not very useful since the maximum household income could be an outlier.
Share = quintile group share of total household income per adult equivalent
Sources: TIA02 & TIA05

If the distribution of household income/AE was equal, the share of all household income for each quintile would be 20 percent. However, the share of all household income is only about 2 percent for the poorest households (quintile 1). In line with Figure 4, Table 6, and Figure 6, Table 7 suggests that income distribution is more skewed in the latter period than it was in 2002.

3.4. COMPARISON OF AGRICULTURAL SEASONS

Rainfall is a critical factor affecting crop production, which contributes the largest share of income for most rural households in Mozambique. To compare the quality of the two agricultural seasons, an estimate of days of drought during the principal maize-growing season was calculated using rainfall data from both seasons. The estimate is based on a water-balance model from Mather *et al.* (forthcoming). Days of drought refer to total days when cumulative precipitation is inadequate for healthy crop growth. Figure 7 shows that in 2005 there were more days of drought than in 2002. With the exception of the central provinces of Sofala and Tete, all other provinces experienced a significant increase in days of drought (P-value < 0.01), which contributed to relatively lower crop production in the 2004/05 agricultural season.

Figure 7. Days of drought by province and year

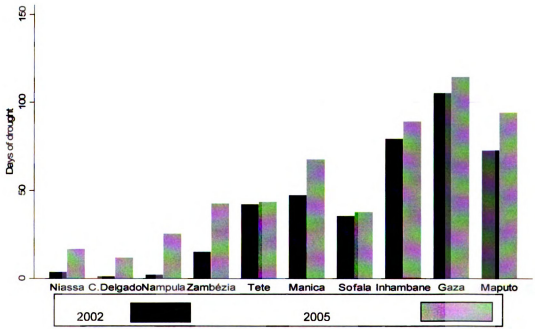
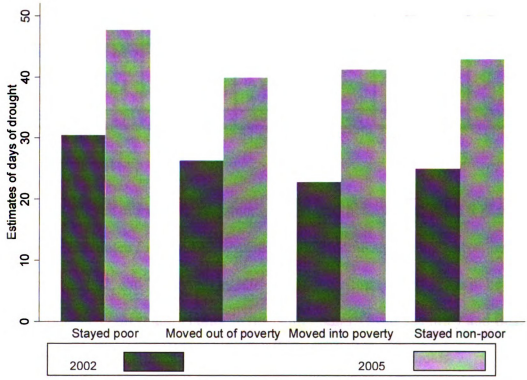


Figure 8 shows that there were more days of drought in 2005 than in 2002 for all four household poverty categories. In addition, households staying poor experienced more days of drought than the other poverty categories of households. Nevertheless, Figure 8 could be a reflection of differences in geographical factors. Days of drought were therefore computed at the district level. Ideally, days of drought at the village level would be a better indicator in explaining movements from and into poverty, but data is not available at this level of disaggregation.

Figure 8. Mean days of drought by poverty category in 2002 and 2005



Days of drought have a significant impact on household income, given that crop income accounted for about 73 percent of total income in 2002 and 65 percent in 2005 (Table 8). Because there were more days of drought in 2005, the expectation is for the share of crop

income to decrease and the share of non-farm income to increase between periods. This is indeed the case, except among households falling into poverty. This suggests that households moving into poverty are those relatively more dependent on rainfed agriculture as an income source, and hence more vulnerable to weather shocks. However, the increase in non-farm income should not be interpreted as a structural change since the two seasons differ in terms of rainfall, and since the data only cover a three year-period.

Table 8. Shares of different income sources by poverty category and year

Poverty category	Income source (%)									
	Livestock		Remittance		Crop		Wages		Self-employment	
	2002	2005	2002	2005	2002	2005	2002	2005	2002	2005
Stayed poor	2.8	2.6	4.0	5.2	76.0	66.1	6.6	10.8	10.6	15.2
Moved out of poverty	3.0	2.7	3.3	4.2	68.1	54.4	8.5	13.9	16.9	24.7
Moved into poverty	2.2	2.1	2.5	4.8	63.5	68.1	11.6	11.0	20.1	13.9
Stayed non-poor	2.1	2.3	1.4	2.8	61.3	54.0	15.7	17.2	19.4	23.7
National	2.7	2.5	3.6	4.9	72.9	64.6	8.0	11.6	12.7	16.3

Sources: TIA02 & TIA05

Crop income is even more important among the poorest households. Table 9 shows that crop income accounted for about 83 percent of total income among the lowest income quintile/AE in 2002, and 72 percent in 2005. Thus, the effects of drought will be more severe among the poorest households. In line with findings from Tschirley and Benfica (2001), off-farm income is concentrated among high income households.

Table 9. Shares of each income source by quintile and year

Income source		Livestock		Crop		Remittance		Salary		Self-employment	
Year		2002	2005	2002	2005	2002	2005	2002	2005	2002	2005
Household income quintiles/AE in each year	Lowest	3.3	3.8	82.7	71.8	4.3	7.0	2.1	6.9	7.6	11.2
	2	2.9	3.0	81.0	72.4	3.0	4.7	3.6	8.1	9.4	12.2
	3	2.5	2.5	77.2	65.4	3.4	4.5	6.4	11.3	10.5	16.4
	4	2.5	2.2	70.3	62.6	3.1	4.4	11.5	13.2	12.5	18.3
	Highest	2.2	1.4	52.9	51.4	4.4	4.0	16.0	19.2	24.4	24.4
National		2.7	2.5	72.9	64.6	3.6	4.9	8.0	11.6	12.7	16.3

Sources: TIA02 & TIA05

3.5. POVERTY IN RURAL MOZAMBIQUE

Table 10 presents poverty headcount, poverty gap, and squared poverty gap at the national level. In line with the results presented in Table 3, poverty headcount did not increase significantly between 2002 and 2005 (P-value = 0.4818). The poverty gap and squared poverty gap measures have significantly increased between the two periods however.

Table 10. Poverty measures using predicted household income/AE by year

Poverty indicator	Value of poverty indicator at national level		
	2002	2005	Change
Head count	83.2	84.1	0.9
Poverty gap	40.6	43.7	3.2
Squared poverty gap	23.5	26.5	3.0

Notes: Change = poverty indicator in 2005 minus poverty indicator in 2002
Sources: TIA02 & TIA05

The next sections analyze different dimensions of poverty in rural Mozambique. We start by looking at spatial dimension of poverty, followed by the demographic dimension. We then analyze the role of off-farm income in reducing rural poverty, and the relationship between landholdings and poverty. The last section of this chapter looks at the relationship between agricultural practices and poverty.

3.5.1 SPATIAL DIMENSION OF POVERTY

Table 11 shows that poverty has a geographical dimension. To test whether the differences in poverty across provinces are significant, we compute the χ^2 statistic, which has a value of 312. The probability that a random variable drawn from a χ^2 distribution with 27 degrees of freedom is greater than 312 is smaller than 0.01. Thus, we reject the null hypothesis of independence between the province and poverty headcount between the two periods[8].

Table 11. Poverty transition matrix by province

	% Head count based on food poverty lines per adult equivalent				Sample (%)
	Poor in 2002 that ...		Non-poor in 2002 that ...		
Province	Stayed poor	Moved out of poverty	Moved into poverty	Stayed non-poor	
Niassa	70.1	12.2	9.1	8.7	5.6
Cabo Delgado	78.5	15.7	3.6	2.2	11.0
Nampula	74.0	6.2	14.5	5.3	21.6
Zambézia	73.5	7.6	14.2	4.6	23.5
Tete	66.3	7.6	15.4	10.7	8.7
Manica	76.4	7.7	8.5	7.5	6.8
Sofala	49.2	32.2	7.4	11.2	5.3
Inhambane	70.6	11.6	10.7	7.2	8.2
Gaza	90.9	5.0	2.0	2.2	7.0
Maputo prov.	88.9	4.3	5.4	1.4	2.3
National	73.6	9.8	10.8	5.8	100.0

Pearson: Uncorrected $\chi^2_{(27)}$ = 312.0579; Design-based F(12.46, 2293.12)= 3.6163 P = 0.0000
Sources: TIA02 & TIA05

Non-poor households were least likely to fall into poverty and poor households more likely to move out of poverty in the central province of Sofala. In contrast, the southern provinces of Maputo and Gaza have the highest percentage of households remaining poor. The cases of Nampula and Zambézia provinces are of particular concern since they constitute about 45 percent of the whole *TIA* sample, and most of the households moving into poverty are located in that region. Previous study has also shown that the

[8] All poverty measures presented in this section are based on predicted household income/AE.

performance of Nampula is below the national average (Boughton *et al.*, 2006), which may suggest the existence of poverty traps.

3.5.2 DEMOGRAPHIC DIMENSION OF POVERTY

Besides geographical location, demographic characteristics such as gender of household head are also related to poverty status. The percentage of households remaining poor is higher among households headed by a female (Table 12). Furthermore, male-headed households are more likely to have moved out of poverty than the female-headed ones.

Table 12. Poverty transition matrix by gender of household head

Gender of household head	% Head count based on per capita food poverty lines				% of Total HH
	Poor in 2002 that ...		Non-poor in 2002 that ...		
	Stayed poor	Moved out of poverty	Moved into poverty	Stayed non-poor	
Female in both years	89.0	3.4	6.1	1.5	22.3
Now male headed	71.1	21.3	5.9	1.8	1.9
Now female headed	77.5	6.1	14.1	2.3	5.1
Male in both years	68.5	11.8	12.2	7.5	70.7
Total	73.6	9.8	10.8	5.8	100.0

Pearson: Uncorrected $\chi^2_{(9)}$ = 173.3602; Design-based F(6.93, 1275.32)= 15.4647 P = 0.0000
Sources: TIA02 & TIA05

In general, household size has increased for all households with the exception of those moving out of poverty (Table 13). The difference in household size and composition between households moving out of poverty and those staying non-poor was significant in 2002, but not significant in the latter period. Table 13 also shows that mean household income/AE in 2002 was significantly higher among households moving out of poverty compared to those who stayed poor. Likewise, households moving into poverty had lower mean and median incomes than those staying non-poor.

Table 13. Household size and composition in each year by poverty transition category

	Poor in 2002 that...		Non-poor in 2002 that...		National mean
	Stayed poor	Moved out of poverty	Moved into poverty	Stayed non-poor	
2002 variables					
Mean number of hh members	5.1	5.2	4.5	4.5	5.0
Mean household size (AE)	3.8	3.9	3.5	3.5	3.7
Mean number of members aged 0-4	0.9	0.9	0.7	0.6	0.8
Mean number of members aged 5-14	1.5	1.5	1.1	1.3	1.5
Mean number of members aged 15-59	2.4	2.6	2.4	2.5	2.4
Mean number of male members aged 15-59	1.1	1.3	1.2	1.3	1.1
Mean number of female members aged 15-59	1.3	1.3	1.3	1.3	1.3
Mean predicted HH income/AE	1,558	1,820	4,262	6,678	2,173
Median predicted HH income/AE	1,560	1,817	4,318	6,819	2,191
2005 variables					
Mean number of hh members	5.4	5.1	4.8	5.0	5.3
Mean household size (AE)	4.0	3.8	3.7	3.9	3.9
Mean number of members aged 0-4	0.8	0.8	0.8	0.8	0.8
Mean number of members aged 5-14	1.8	1.6	1.3	1.4	1.7
Mean number of members aged 15-59	2.5	2.5	2.5	2.6	2.5
Mean number of male members aged 15-59	1.1	1.3	1.2	1.3	1.2
Mean number of female members aged 15-59	1.4	1.2	1.3	1.3	1.3
Mean predicted HH income/AE	1,478	4,784	1,679	7,846	2,192
Median predicted HH income/AE	1,479	4,776	1,680	7,892	2,199

Sources: TIA02 & TIA05

3.5.3 OFF-FARM INCOME AND POVERTY

There are significant differences across provinces in terms of off-farm labor opportunities. On average, at least one member of each household is self-employed in Sofala in 2005, compared to one self-employed member for every two households in Nampula and Zambézia. In general, households dwelling in Northern provinces have fewer non-farm employment opportunities.

Table 14 presents information on household participation in off-farm income sources in relation to transition in poverty status between survey periods. Whereas in 2002 there was no significant difference in the number of salaried members between households

moving out of poverty and those staying poor, households moving out of poverty by 2005 had significantly more salaried members than those staying poor (P-value<0.0001). With the exception of those moving into poverty, the number of salaried or self-employed members increased among all other poverty groups between 2002 and 2005 (Table 14). Likewise, the percentage of households whose head is salaried or self-employed has significantly increased, even among those who stayed poor, but decreased among households moving into poverty. Though agriculture is very important in rural Mozambique, especially among the poorest households, Table 14 shows that non-farm income is crucial in lifting households out of poverty and in preventing the non-poor from falling into poverty. The loss of non-farm income is associated with falling into poverty.

Table 14. Household farm and non-farm employment by poverty transition category

	Poor in 2002 that …		Non-poor in 2002 that …		National mean
	Stayed poor	Moved out of poverty	Moved into poverty	Stayed non-poor	
2002 variables					
Number of salaried members (Mean)	0.2	0.2	0.5	0.4	0.2
Number of self-employed members (Mean)	0.4	0.5	0.9	0.8	0.5
Households whose head is salaried (%)	11.7	12.0	30.0	27.4	15.1
Households whose head is self-employed (%)	26.5	37.1	56.1	57.8	32.6
Agriculture is the head's main activity (%)	87.3	80.2	79.1	69.2	84.7
Agriculture is head's secondary activity (%)	9.9	17.1	19.1	27.1	12.6
Agriculture is not head's activity (%)	2.8	2.7	1.9	3.7	2.7
2005 variables					
Number of salaried members (Mean)	0.4	0.8	0.4	0.6	0.4
Number of self-employed members (Mean)	0.6	1.3	0.5	1.2	0.7
Households whose head is salaried (%)	22.1	36.0	25.7	36.1	25.1
Households whose head is self-employed (%)	37.2	70.8	36.8	70.3	42.4
Agriculture is the head's main activity (%)	86.3	77.2	85.8	70.3	84.4
Agriculture is head's secondary activity (%)	10.3	21.5	11.7	27.3	12.6
Agriculture is not head's activity (%)	3.4	1.3	2.6	2.5	3.0

Sources: TIA02 & TIA05

We now look at the contributions of each of the non-farm employment types in lifting poor households out of poverty and helping the non-poor avoid falling into poverty. Wage income is divided into three categories: (i) unskilled agricultural wage; (ii) unskilled non-agricultural wage; and (iii) skilled non-agricultural wage. Self-employment is divided into four categories: (i) extraction of forestry or fauna products with low returns; (ii) extraction of forestry or fauna products with higher returns; (iii) other self-employment activities with low barriers to entry but low returns; and (iv) other self-employment activities with higher returns. A list of non-farm activities in each of the 7 categories is found in the appendix A3.

Table 15 presents mean values from non-farm income generating activities for all households in a given poverty category. In general, mean household income from all types of non-farm activities has increased for all poverty groups except those households moving into poverty. In terms of wage income, skilled non-agricultural wage income has the highest mean value in both years, particularly among those who moved out of poverty or stayed non-poor. Among those households moving out of poverty, mean household income from self-employment in low return forestry and fauna activities in 2005 was 7.6 times higher than in 2002, while mean household income from other self-employment activities with high return was 4.5 times. Losing other self-employment income is also highly associated with moving into poverty. Among households staying non-poor, mean household income from forestry and fauna activities is at least 7 times higher in 2005 than in 2002. In addition, mean household income from high return other self-employment activities among those who stayed non-poor is 10.4 times higher in 2005

relative to the mean from those moving into poverty, and 14.5 times higher relative to households staying poor.

Table 15. Mean non-farm income (MTn) by poverty transition category

	Poor in 2002 that...		Non-poor in 2002 that...		National mean
	Stayed poor	Moved out of poverty	Moved into poverty	Stayed non-poor	
Unskilled ag wage income in 2002	163	164	246	536	194
Unskilled ag wage income in 2005	267	501	152	617	297
% change of the mean	63.8	206.1	-38.3	15.2	53.0
Unskilled non-ag wage income in 2002	240	270	302	443	275
Unskilled non-ag wage income in 2005	307	571	273	621	379
% change of the mean	27.9	111.3	-9.8	40.2	37.7
Skilled non-ag wage income in 2002	591	867	1,824	3,489	1,106
Skilled non-ag wage income in 2005	902	2,155	1,550	4,325	1,424
% change of the mean	52.5	148.7	-15.1	24.0	28.8
Self-employment forestry and fauna - low in 2002	79	51	165	28	82
Self-employment forestry and fauna - low in 2005	236	390	93	255	240
% change of the mean	200.7	662.3	-43.6	815.5	192.7
Self-employment forestry and fauna - high in 2002	374	542	811	304	426
Self-employment forestry and fauna - high in 2005	386	424	573	2,215	509
% change of the mean	3.2	-21.8	-29.4	627.5	19.6
Other self-employment - low in 2002	329	590	911	870	481
Other self-employment - low in 2005	412	1,063	521	1,093	543
% change of the mean	25.4	80.3	-42.8	25.6	12.9
Other self-employment - high in 2002	706	1,115	2,372	9,904	1,698
Other self-employment - high in 2005	799	5,010	1,112	11,548	1,851
% change of the mean	13.2	349.2	-53.1	16.6	9.0

Sources: TIA02 & TIA05

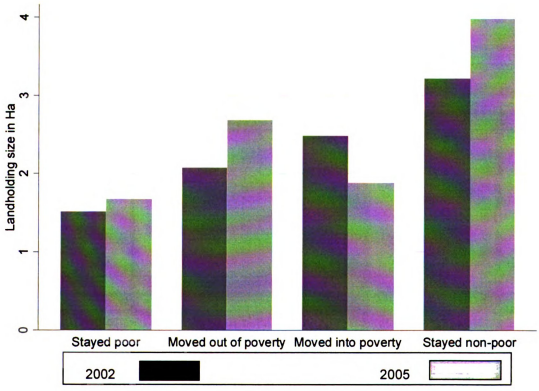
Table 15 confirms the hypothesis that the non-poor are less vulnerable to natural calamities such as the drought that occurred in 2005. Households staying poor were able to increase their income from all off-farm activities, but the increase was not great enough to lift them out of poverty. Households moving out of poverty had a large percentage increase from almost all off-farm activities except high return extraction of forestry and fauna resource activities. In contrast, households moving into poverty

experienced decreases in mean income from all off-farm sources. Thus, diversification into non-farm income opportunities is important for reducing poverty in rural Mozambique.

3.5.4 LANDHOLDING SIZE AND POVERTY

Figure 9 shows total landholding size in hectares by poverty transition group. With the exception of those moving into poverty, average landholding size has increased among all other poverty categories, including those who stayed poor. Landholding size has significantly decreased among households falling into poverty, however.

Figure 9. Mean total landholding size in hectares by poverty category and year



In both years, households staying non-poor had significantly more land than those moving into poverty, and those moving out of poverty had significantly more land than households staying poor.

Returning to the discussion of distinguishing chronic from transitory poverty, Table 16 shows the number of households among those who moved out of poverty that could meaningfully be said to have escaped poverty. These households meet the criteria that their predicted income/AE and their total land holding/AE in the latter period exceed the median income/AE and land holdings of those staying non-poor in each province. About 20 percent of those moving out of poverty can be considered to have escaped poverty on the basis of these criteria. However, meeting these criteria does not guarantee that these households' "escape from poverty" will be permanent, and it would be interesting to follow these households in future surveys[9].

Table 16. Number of households "escaping" poverty by province between 2002 and 2005

Province	Moved out of poverty	*Escaped poverty*	*Percent*
Niassa	26	4	15.4
Cabo Delgado	62	17	27.4
Nampula	30	4	13.3
Zambézia	52	6	11.5
Tete	34	4	11.8
Manica	22	2	9.1
Sofala	90	17	18.9
Inhambane	37	17	45.9
Gaza	35	9	25.7
Maputo Prov.	15	2	13.3
National	403	82	20.3

Sources: TIA02 & TIA05

[9] The results from Table 16 are not population-weighted, because these households represent a small fraction of the whole population.

3.5.5 AGRICULTURAL PRACTICES AND POVERTY

In terms of agricultural practices and access to services, two distinct patterns are noteworthy. First, the use of agricultural inputs (fertilizer, pesticides, and animal traction) has increased among households moving out of poverty, even though it declined nationally and among those moving into poverty (Table 17). Second, the use of fertilizers also increased among households staying non-poor.

Table 17. Agricultural technology use and access to services by poverty transition category

	Poor in 2002 that ...		Non-poor in 2002 that ...		National
	Stayed poor	Moved out of poverty	Moved into poverty	Stayed non-poor	
2002 variables					
Fertilizer use (%)	2.2	4.8	5.7	17.1	3.8
Pesticide use (%)	5.9	6.8	8.9	13.7	6.7
Animal traction use (%)	10.4	11.3	14.4	19.8	11.1
Hired permanent labor (%)	0.5	0.5	6.8	15.3	2.1
Hired seasonal labor (%)	8.4	18.2	39.8	55.8	15.5
Grow cotton (%)	6.2	9.2	12.1	9.3	7.2
Grow tobacco (%)	2.1	3.5	9.4	16.0	3.8
Received price information (%)	30.7	34.3	55.6	49.9	34.5
Access to extension services (%)	11.4	17.6	21.9	21.9	13.7
Membership to ag. Association (%)	3.0	3.1	7.4	9.7	3.8
2005 variables					
Fertilizer use (%)	1.7	6.8	5.0	18.5	3.5
Pesticide use (%)	4.0	9.5	5.5	12.8	5.1
Animal traction use (%)	8.6	11.5	5.3	14.5	8.6
Hired permanent labor (%)	0.7	4.5	2.0	9.3	1.6
Hired seasonal labor (%)	9.5	59.1	15.9	64.0	18.0
Grow cotton (%)	4.6	9.8	7.4	9.6	5.6
Grow tobacco (%)	1.1	7.6	2.0	15.0	2.6
Received price information (%)	35.9	66.2	39.9	62.5	40.3
Access to extension services (%)	14.0	27.7	13.5	26.0	15.7
Membership to ag. Association (%)	5.6	12.7	7.2	11.7	6.8

Sources: TIA02 & TIA05

CHAPTER IV REGRESSION ANALYSIS

This chapter describes the regression methods and results used to obtain predicted household income/AE in each year, and analyze factors associated with income change and moving into or out of poverty. It starts with a description of the methods used to predict rural household income, followed by the description of independent variables. The first-difference model and the multinomial logit regression results are presented later in this chapter.

4.1. PREDICTING RURAL HOUSEHOLD INCOME

As discussed in Section 1.2.3, one of the difficulties when using reported income measures over time is to distinguish between structural and transitory poverty. This is particularly true when the data only covers a short period (as in our three-year panel dataset). Since rural income varies with agricultural season, most of the movement into and out of poverty between seasons will likely be classified as transitory. Using the rural household's predicted income can potentially purge the influence of one other source of transitory income shocks, namely household idiosyncratic shocks (McKay and Lawson, 2002). As a result, predicted income should more closely approximate longer-term or expected household income than actual income in any given period. Therefore, in order to subsequently classify the households according to their poverty status, we estimate predicted household income with the following model using the Ordinary Least Squares method (OLS):

$$(5) \quad \log(y_{it}) = f(X_{it})$$

where y_{it} is the household i's income/AE in year t and X is a vector of the independent variables, which includes household characteristics, technology, access to services, asset holdings, and locale-specific conditions such as differences in agricultural potential.

Demographic characteristics comprise an important subset of independent variables. The household head's age is included to capture potential lifecycle effects. Other demographic characteristics are related to changes in household size and composition, the head's years of education, and the gender of the household head. Similar to larger households, those with a high dependency ratio (ratio of children and seniors to household size) are expected to have less income per AE than their counterparts. Previous studies on rural poverty in Mozambique have also shown that female-headed households have relatively less income than male-headed households (Boughton *et al.*, 2006; Walker *et al.*, 2004).

Labor-market participation will also influence rural income (Tschirley and Benfica, 2001). Households with one or more salaried members will have a steadier income than those relying only on agriculture. Similarly, households with self-employed members are likely to have a higher and steadier income. Tables 14 and 15 in the previous chapter highlighted the importance of labor-market participation both in lifting poor households out of poverty, and to avoid the non-poor from falling into poverty.

Since crop income constitutes a large fraction of total household income, landholding size will have an impact on household income. The expectation is that households that have access to more land will have higher income levels. Nevertheless, the marginal effect of increases in farm size is likely to differ across agro-ecological zones or provinces due to differences in rainfall patterns and soil fertility. Some of the differences are captured by using regional models rather than a national model. Other assets that can help explain household income include livestock herd size (cattle), which are expressed in Tropical Livestock Units (TLU) using conversion ratios from FAO (2007).

Since crop income is an important component of household income and most crop production is rainfed, we expect differences in rainfall patterns to have a significant effect on household income. The effect of rainfall is controlled for using the number of drought days at district level. District-level dummy variables capture the influence of other district-specific exogenous shocks to household income.[10]

Technology use was proxied using variables such as whether the household has used improved seeds, animal traction, crop rotation, hired labor, and line sowing. The use of fertilizer was not included as an independent variable because most of the fertilizer used in Mozambique is applied to tobacco, and we are already controlling for the cultivation of

[10] Dummies for agroecological zones were initially included, but then dropped out of the models because of their potential collinearity with district dummies (dropping agroecological dummies did not change the results significantly). District dummies are preferred in our case because they are more disaggregated than agroecological zone dummies.

this crop. As for any choice variable, technology variables are potentially subject to endogeneity. An endogenous variable can be defined as one that is partially determined by other factors within the model (observable explanatory variables that are correlated with unobservable error terms). One of the key assumptions of Ordinary Least Squares (OLS) is that explanatory variables are uncorrelated with the error term. When this assumption is violated, OLS estimation is biased and inconsistent, and hence *t*-tests and *F*-statistics are not reliable. Since testing for the presence of endogeneity when using survey weights is difficult in many statistical packages, and using an instrumental variable approach depends on finding the appropriate instruments, which is usually difficult, we interpret the results for technology variables with appropriate caution. Similar caveats apply to the variables on access to rural extension services and price information, and membership in an agricultural association. The information regarding the use of improved seeds, crop rotation, and line sowing was only collected in 2005. Hence, these variables are only included in the 2005 cross-section models and multinomial logit models.

We suspect that coefficient estimates may differ across regions. Rather than having one national model, we estimate three regional cross-section models for each year and present the results in Table 18. The Chow Statistic can be used to evaluate whether the three regional models are better than one national model for each year and is presented when discussing the first-difference models in the next section. All six models seem to fit the data reasonably well for both years. Robust standard errors were used in both models to correct for heteroskedasticity. R-squared statistics for the 2001/02 agricultural season

regressions are relatively higher than those for the 2004/05 agricultural season, and in both years the R-squared is lower in the south.

Growing tobacco is positively and significantly correlated with higher income levels in all three regions except in the south in 2004/05 agricultural season. The effect of growing either tobacco or cotton in central provinces is higher than the effect of growing the same crops in northern provinces. Differences between the two regions may stem from the relatively low performance of cotton and tobacco companies in northern provinces and differences in rainfall patterns. The result of growing tobacco in the south being associated with losses in household income per adult equivalent in 2004/05 agricultural season is probably due to the more severe drought in that year (few households grow tobacco in the south and they tend to be located in the same area).

Growing cotton was only significant and positively correlated with higher income levels in 2002/02 agricultural season in the center. This result could be an artifact of the weather and may also be related to the performance of cotton growers in the north. Days of drought did not significantly change in the center, and cotton companies in the north seem to have relatively lower performance than their counterparts in the center (Tschirley et al., 2006).

Table 18. Results from cross-section models for each year and region

Dependent variable:	2001/02 Agricultural Season			2004/05 Agricultural Season			Mean in	Mean in
Log of total household income/AE	North	Center	South	North	Center	South	2002	2005
Demographics								
Number of members aged 0-4	-0.132 ***	-0.075 **	-0.063	-0.109 ***	-0.010	0.016	0.833	0.799
Number of members aged 5-14	-0.094 ***	-0.146 ***	-0.090 ***	-0.120 ***	-0.151 ***	-0.111 ***	1.478	1.689
Number of members aged 60 or older	-0.174 **	-0.221 **	-0.299 ***	-0.152 **	-0.072	-0.221	0.232	0.267
Number of male members aged 15-59	-0.137 ***	-0.185 ***	-0.193 ***	-0.194 ***	-0.143 ***	-0.166 **	1.129	1.178
Number of female members aged 15-59	-0.117 ***	-0.076 **	-0.158 ***	-0.200 ***	-0.163 ***	-0.165 ***	1.293	1.338
Head's years of schooling	0.049 ***	0.060 ***	0.091 ***	0.070 ***	0.061 ***	0.090 ***	2.200	1.960
Head's age	-0.009	0.023	0.016	0.006	0.022	0.010	42.022	44.369
Head's age squared	0.000	0.000	0.000	0.000	0.000	0.000		
Head's gender (1=Male)	0.079	0.249 *	0.095	0.143 **	0.068	0.032	0.758	0.725
Labor-market participation								
Number of salaried members	0.410 ***	0.253 ***	0.373 ***	0.139 ***	0.121 **	0.357 ***	0.242	0.444
Number of self-empl. Members	0.286 ***	0.326 ***	0.303 ***	0.259 ***	0.225 ***	0.171 ***	0.477	0.691
Access to public services								
Access to extension services (1=Yes)	0.118 *	-0.092	0.050	0.083	0.028	0.045	0.137	0.157
Membership to ag. Association (1=Yes)	0.207 **	0.042	0.065	0.070	0.013	-0.001	0.038	0.068
Access to price info (1=Yes)	0.042	0.236 ***	0.138	0.170 ***	0.313 **	0.106	0.387	0.403
Agricultural technology								
HH used animal traction (1=Yes)	NA	0.360 ***	0.051	0.166	0.425 ***	-0.222	0.113	0.088
HH used of permanent labor (1=Yes)	0.575 ***	0.449 **	0.574 **	-0.072	0.372	0.258	0.021	0.016
HH used seasonal labor (1=Yes)	0.328 ***	0.423 ***	0.414 ***	0.556 ***	0.446 ***	0.380 *	0.157	0.180
HH does line sowing (1=Yes)	NA	NA	NA	0.094	0.015	-0.154	NA	0.416
HH does crop rotation (1=Yes)	NA	NA	NA	-0.056	0.200 *	0.002	NA	0.377
HH used improved seeds (1=Yes)	NA	NA	NA	0.051	0.395	0.518 *	NA	0.041
Cultivation of cash crops								
HH grows cotton (1=Yes)	-0.017	0.235 **	0.723	-0.009	-0.062	NA	0.073	0.057
HH grows tobacco (1=Yes)	0.295 ***	0.454 ***	0.513 **	0.382 ***	0.723 ***	-0.530 ***	0.039	0.026
Household assets								
Landholding size (Hectares)	0.185 ***	0.113 ***	0.036 *	0.182 ***	0.115 ***	0.123 *	1.762	1.920
Landholding size squared	-0.002 ***	-0.001 ***	0.000 **	-0.004 ***	-0.001 ***	-0.002 **		
Tropical livestock units	0.012	0.028 ***	0.026 ***	0.103 ***	0.027 ***	0.028 ***	0.996	0.985
Agricultural potential								
Days of drought	0.002	0.006 ***	-0.035 ***	-0.018 ***	-0.015 ***	-0.028 ***	28.665	45.731
Intercept	7.421 ***	5.956 ***	9.596 ***	7.565 ***	7.187 ***	9.965 ***		
R-squared	0.40	0.42	0.34	0.31	0.29	0.20		
Number of observations	1728	1164	1109	1723	1153	1091		

Notes: *** significant at .01 level; ** significant at .05 level; * significant at .10 level;

District dummies are included; NA - Not applicable (No observations)

Sources: TIA02 & TIA05

With the exception of household head age, and number of infants in the south, all demographic characteristics such as household size and composition are significantly correlated with household income/AE. For example, adding one member to the household decreases the income/AE, regardless of age category, and the effect is usually larger when the additional member is an elderly person (age 60 or older). Male-headed households had significantly higher income levels than female-headed households in central provinces in 2002, and in northern provinces in 2005.

The number of years of educational attainment of the household head is significantly and positively correlated with household income/AE, and the coefficients are slightly higher in 2005. Differences in educational attainment could become more important during a drought year because non-agricultural wage income can be used to smooth crop income losses due to bad weather. The number of salaried and self-employed members in the household is another factor that is correlated with higher household income per adult equivalent. Households with members engaged in off-farm activities can have a more steady income source, and make up for losses in crop production during a bad agricultural season. National means for both salaried and self-employed household members were higher in 2005 compared to 2002.

As expected, the number of drought days is correlated with household income. In 2005, days of drought is highly significantly and negatively correlated with household income/AE in all three regions. However, in 2002, days of drought is significant and positively correlated with household income/AE in central provinces. One possible

explanation for this unexpected result could be the fact that many household members in central provinces (particularly in Sofala province) suffering from drought may have engaged in more lucrative types of non-farm activities.

Turning to agricultural technology variables, the use of animal traction is positively and significantly correlated with household income in both years in central provinces, but not significant in southern provinces. For other agricultural technology variables (2005 only), the use of crop rotation is positively and significantly correlated with household income/AE in central provinces. The use of improved seeds is positively correlated with household income/AE only in southern region, while line sowing was not significant. The fact that few households use improved seeds and the more widespread occurrence of drought in 2005 may be the reason why its use was not statistically correlated with increases in household income/AE.

In terms of assets, landholding size is positively and significantly correlated with household income/AE in all three regions in both years. The squared term in landholding size indicates diminishing marginal returns. The impact of landholding size is larger in northern provinces, followed by central provinces, reflecting differences in agricultural potential between the three regions. With the exception of northern provinces in 2002, Tropical Livestock Units are positively and significantly correlated with household income/AE in both years.

Predicted household income/AE from cross-section regressions presented on Table 18 was used to classify the households into four mutually exclusive groups: (i) stayed poor; (ii) moved out of poverty; (iii) moved into poverty; and (iv) stayed non-poor. These four poverty categories are then used as the dependent variable in the multinomial logit regressions presented in section 4.3.

4.2. FIRST-DIFFERENCE MODEL

This section attempts to model the factors associated with rural income change over time. The dependent variable is the change in the log of household income/AE between 2002 and 2005. Similar to the cross-section regressions discussed in the previous section, the first-difference model uses reported household income. Predicted income/AE is used in the multinomial logit regression, presented in the next section.

The first-difference model can be represented as

$$(6) \quad \log\left(\frac{y_{it}}{y_{i(t-1)}}\right) = f(\Delta X)$$

where y is the household's income/AE at time t (or t-1) and the independent variables represent changes between the two periods. Variables that do not vary over time drop out of the model. District dummy variables and household head's age in the 2002 are interacted with a time variable.

The two common sources of endogeneity are omitted variable bias and reverse causation. The first-difference model corrects for endogeneity caused by the former case when the

omitted variables are constant over time (Wooldridge, 2002a), but does not correct for endogeneity due to reverse causation.

We estimate four models. As in the case of cross-section models presented earlier, the first-difference model results presented in Table 19 are corrected for heteroskedasticity using robust standard errors, and they were weighted using the IPW method to correct for attrition bias (Mather and Donovan, forthcoming). The first model uses the entire sample, whereas the other three models use regional sub-samples. The Chow statistic is computed to test the null hypothesis that the three regions follow the same regression function, against the alternative that one or more of the slopes differ across the three regions. We reject the null hypothesis at the .01 level, and thus separate regional models are preferred to a national model. In addition, some coefficients differ across regions in terms of their magnitude and sign. The discussion that follows is restricted to regional models.

Differences in rainfall patterns are driving some of the changes in household income/AE. The increase in days of drought is significantly and negatively correlated with reduction in household income in the northern and southern provinces. The estimated coefficient for a change in days of drought is not significant in central provinces. Because the share of crop income is high, particularly among the poor, the reduction in crop income due to increases in days of drought has contributed to a decrease in total household income among those affected by a drought. The negative coefficient for increase in days of drought was highest in the southern provinces.

Table 19. First-difference model results by region

	All regions	North	Center	South
Demographics				
Change in the # of members aged 0-4	-0.052 **	-0.088 ***	-0.007	-0.024
Change in the # of members aged 5-14	-0.068 ***	-0.068 **	-0.130 *	-0.079 *
Change in the # of members aged 60 or older	-0.291 ***	-0.363 ***	-0.087	-0.370 ***
Change in the # of male members aged 15-59	-0.147 ***	-0.184 ***	-0.146 **	-0.179 **
Change in the # of female members aged 15-59	-0.152 ***	-0.234 ***	-0.175 **	-0.068
Head's years of schooling in 2002*time	0.020 *	0.022	0.043 *	-0.012
Head's age in 2002*time	-0.001	0.000	-0.003	-0.002
Change in head's gender	0.262 ***	0.164	0.401 *	0.178
Labor-market participation				
Change in the # of salaried members	0.247 ***	0.217 ***	0.190 ***	0.416 ***
Change in the # of self-empl. members	0.266 ***	0.278 ***	0.291 ***	0.245 ***
Access to public services				
Change in access to extension services	0.002	0.105	-0.257 **	-0.100
Change in membership to ag. association	0.063	0.065	0.028	0.043
Change in access to price info	0.152 ***	0.114 **	0.240 **	0.138
Agricultural technology				
Change in the use of animal traction	-0.179	NA	-0.126	-0.236
Change in the use of permanent labor	0.034	-0.154	0.025	0.233
Change in the use of seasonal labor	0.281 ***	0.340 ***	0.258 ***	0.046
Assets				
Change in landholding size	0.044 ***	0.133 ***	0.111 ***	0.018 *
Change in landholding size: squared term	0.000 **	-0.002 ***	-0.001 ***	0.000 *
Change in tropical livestock units	0.041 ***	0.073 ***	0.034 ***	0.025
Cultivation of cash crops				
Change on whether the HH grows cotton	0.203	0.106	0.395	0.403
Change on whether the HH grows tobacco	0.284 ***	0.156	0.543 **	0.273
Agricultural potential				
Change in days of drought	-0.010 **	-0.008 *	0.002	-0.019 ***
Intercept	-0.370 **	-0.024	-0.016	0.104
R-squared	0.177	0.205	0.218	0.148
Number of observations	4038	1746	1169	1123
Chow Statistic	6.940 ***			

Notes: *** significant at .01 level; ** significant at .05 level; * significant at .10 level

District dummies are included; NA - animal traction is not frequent in the north

Sources: TIA02 & TIA05

In general, an increase in household size will result in a decrease in household income per adult equivalent, other things being equal, regardless of the age group of the new member. We expect a positive relationship between changes in income and changes in the number of household members aged 15-59 due to an increase in labor availability both for agricultural and non-agricultural activities. However, even for this age group, the additional income generated by new household members does not appear to be large enough to compensate for an increase in household size, hence resulting in a net decrease in household income per adult equivalent.

Household head's years of educational attainment in 2002 and change in head's gender were only significant in increasing household income/AE in central provinces. Over time the return to household head educational attainment has appreciated in central provinces, and households that became male-headed in 2005 but were female-headed in 2002 have significantly increased their incomes. Similar to cross-section regression results, the effect of educational attainment is particularly prominent during a drought year. Households with a larger share of crop income that depend on a rainfed agriculture are more vulnerable to weather shocks, whereas those whose head's educational attainment allows them to participate in the non-agricultural labor market can sustain a steadier income source, and hence be less vulnerable to natural calamities.

In terms of labor-market participation, an increase in the number of salaried or self-employed members is positively correlated with increases in household income/AE in all three regions. The impact of a change in the number of household members with salaried

employment on household income/AE is higher in the south. Nonetheless, labor market participation is potentially an endogenous variable. Although the first-difference model corrects for endogeneity caused by omitted time-invariant variables, it does not correct for endogeneity caused by reverse causation. One way of dealing with such potential problem is to use an instrumental variable approach. We refrain from using this method because it is hard in practice to find good instruments.

The adoption of tobacco resulted in significant increases in household income per adult equivalent in the central region. Unlike in the south where the coefficient on adoption of tobacco was not significant due to the smaller number of tobacco growers, the absence of a statistically significant coefficient in the north may be an artifact of the weather or lower performance of tobacco companies in the north, or a combination of both factors.

Increases in landholding size are associated with increases in household income per adult equivalent. Similar to the cross-section OLS results presented in the previous section, the effect is higher in the north, followed by central provinces. The squared term on landholding size show that the marginal effect of increasing landholding size decreases with the expansion of farm size. Increases in Tropical Livestock Units were also significantly correlated with increases in total household incomes in northern and central provinces.

4.3. MULTINOMIAL REGRESSION MODEL

The multinomial logit regression is used to assess the impact of household characteristics on the odds of moving from one poverty group to another (relative to the base group). The multinomial logit model can be represented as:

$$(7) \quad P(Y_i = j) = \frac{e^{\beta_j' X_i}}{1 + \sum_{k=1}^{J} e^{\beta_k' X_i}}, \quad for \ j = 1,2,...,J$$

and

$$(8) \quad P(Y_i=0) = \frac{1}{1 + \sum_{k=1}^{J} e^{\beta_k' X_i}}, \quad for \ j=0$$

The X_i variables correspond to the right-hand-side variables that influence the probability of a given household belonging to a certain poverty category (Y_i). A description of the independent variables that make up the X_i vector was provided in previous sections.

A household is deemed to have stayed poor if its predicted income is below the poverty line in both periods, while a household is non-poor if its predicted income is above the poverty line in both years. Households moving into poverty are those whose predicted income was above the poverty line in the first period but below the poverty line in the latter period. Lastly, households moving out of poverty have their predicted income

below the poverty line in the first period but above it in the second period. For this particular study J=4 (running from 0 to 3), where P(Y_i=0) is the probability that the household has stayed poor, P(Y_i=1) is the probability of moving out of poverty, P(Y_i=2) represents the probability of moving into poverty and P(Y_i=3) the probability of staying non-poor.

One of the key assumptions of the multinomial logit model is the Independence of Irrelevant Alternatives (IIA), which states that adding or removing one of the poverty categories does not affect the odds among the remaining poverty categories. The assumption regarding IIA can be tested using either the Hausman or the Small-Hsiao test. Sometimes the two tests can give inconsistent results (Long and Freese, 2006). Furthermore, it is not straightforward to perform these two tests when using complex survey weights. We attempted to use the multinomial probit model instead (as it relaxes the IIA assumption) but it proved computationally too time intensive. We decided to continue using a multinomial logit specification, and assume that the IIA assumption is not violated.

The model coefficients presented are relative risk ratios. Standard interpretation of the relative risk ratio (RRR) is that for a unit change in the predictor variable, the relative risk ratio of outcome J relative to the benchmark group is expected to change by a factor of the respective parameter estimate, holding constant the other variables in the model. Variables with RRR (coefficients) greater than one imply that, given a one unit increase in the independent variable, the household's likelihood of belonging to the J^{th} group

relative to belonging to the benchmark group increases. Therefore, the expectation is that when the RRR is less than one and significant in the comparison of moving out of poverty relative to staying poor, then the same variable will have its RRR greater than one when comparing households moving into poverty relative to those who managed to stayed non-poor.

Results from estimation of the four multinomial logit models are presented in Tables 20 through 22. Model 1 is based on actual poverty lines, while in models 2 and 3 the poverty line has been changed upward and downward by 20 percent, respectively, to evaluate the robustness of our conclusions in relation to the poverty line being used[11]. Model 4 uses actual rather than predicted income, and is included for purposes of comparison. Similar to the cross-section models and the first-difference models, we run regional multinomial models and discuss the results separately.

The results from the three models that use predicted incomes are consistent (models 1, 2, and 3). Results from model 4 are slightly different both in terms of the magnitude and the significance of some coefficients. For instance, changes in landholding size, use of hired labor, tropical livestock units and drought days are significant in all three models that use predicted household incomes but not significant in model 4 (where the dependent variable is based on actual household income). The discussion that follows corresponds to model 1.

---

[11] Results from Table 3 showed that poverty incidence can be higher in either period, depending on the poverty line that is used. Thus, it is important to evaluate whether multinomial logit regression results are robust to alternative poverty lines.

4.3.1. MOVING OUT OF AND INTO POVERTY IN THE SOUTH

Starting with the discussion of demographic factors in the south, we find that adding a new household member (ages 5 and above) decreases the probability of moving out of poverty (Table 20). The household head's educational attainment in 2002 is another demographic characteristic that influences the odds of moving out of poverty, relative to staying poor. One additional year of head's educational attainment is associated with an increase in the probability of moving out of poverty by 28 percent.

In terms of labor-market participation, an increase in the number of household members with off-farm income in southern provinces significantly increases the probability of moving out of poverty relative to staying poor. Adding one salaried member increases the probability of moving out of poverty by 400 percent. Moreover, adding one self-employed member increases the probability of moving out of poverty by 77 percent. This confirms the importance of off-farm income for poverty alleviation in rural Mozambique.

Regarding the access to public services, poor households in 2002 that started receiving price information in 2005 have increased their probability of moving out of poverty by almost 190 percent. An unexpected result is that access to extension services decreases the odds of moving out of poverty. One possible explanation for this result is that households who started receiving extension services may be more dependent on crop income and hence more vulnerable to drought.

Table 20. Relative risk ratios from multinomial logit models: southern provinces

	Moved out of poverty relative to stayed poor				Moved into poverty relative to stayed non-poor			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Demographics								
Change in the # of members aged 0-4	0.852	0.851	0.851	0.996	0.941	1.480	1.480	0.938
Change in the # of members aged 5-14	0.728 *	0.683	0.683	0.940	1.040	0.872	0.872	0.944
Change in the # of members aged 60 or older	0.224 ***	0.498	0.498	0.393 ***	1.833	0.881	0.881	0.787
Change in the # of male members aged 15-59	0.343 ***	0.582 **	0.582 **	0.734 *	2.258 ***	1.812	1.812	0.899
Change in the # of female members aged 15-59	0.824	0.772	0.772	1.022	0.388 *	0.269 *	0.269 ***	1.348
Head's years of schooling in 2002	1.283 **	1.653 ***	1.653 ***	1.110	0.861	0.884	0.884	0.908
Head's age in 2002	0.975	0.975 **	0.975 **	0.991	1.027	1.029	1.029	0.998
Change in head's gender	2.747	4.508 **	4.508 **	1.915	0.372	0.624	0.624	1.261
Labor-market participation								
Change in the # of salaried members	5.005 ***	4.426 ***	4.426 ***	1.775 ***	0.146 ***	1.156	1.156	0.767
Change in the # of self-empl. members	1.769 *	1.463	1.463	1.259	0.197 ***	0.272 **	0.272 *	1.120
Access to public services								
Change in access to extension services	0.303 **	0.449 ***	0.449 ***	0.523 **	0.119 **	1.270	1.270	0.551
Change in membership to ag. association	3.579	0.860	0.860	1.322	1.108	2.666	2.666	1.451
Change in access to price info	2.923 *	1.790	1.790	1.020	0.781	0.347	0.347	1.288
Agricultural technology								
Change in the use of animal traction	0.731	0.545	0.545	1.193	0.718	0.674	0.674	1.018
Change in the use of permanent labor	6.402 ***	7.889 ***	7.889 ***	1.091	29.554 *	26.532	26.532	0.824
Change in the use of seasonal labor	6.782 ***	5.097 ***	5.097 ***	1.310	0.073 ***	0.034 **	0.034 **	1.557
HH did line sowing in 2005 (1=Yes)	0.706	0.439	0.439	0.927	0.752	0.009 **	0.009 **	0.835
HH did crop rotation in 2005 (1=Yes)	2.013	1.837 *	1.837 *	1.249	0.784	0.436	0.436	1.266
HH used improved seeds in 2005	5.648	5.502	5.502	0.860	0.148	0.040	0.040	0.251
Household assets								
Change in landholding size	1.109 ***	1.086 **	1.086 **	1.011	1.012	0.979 *	0.979 *	1.044
Change in tropical livestock units	1.232 **	1.241 **	1.241 **	1.019	0.787 *	0.761	0.761	0.960
Cultivation of cash crops								
Change on whether the HH grows cotton								
Change on whether the HH grows tobacco	0.762	0.320	0.320	0.502	4.124	0.001 ***	0.001 ***	6.164
Agricultural potential								
Change in days of drought	0.843 **	0.844 **	0.844 **	1.002	1.138 ***	1.106	1.106	1.044 ***
Number of observations	1082							

Notes: *** significant at .01 level; ** significant at .05 level; * significant at .10 level; District dummies are included

Sources: TIA02 & TIA05

In terms of agricultural technology, hiring labor for agricultural activities is significantly correlated with a higher probability of moving out of poverty, relative to staying poor. Other agricultural technology variables were not significant.

An additional hectare of land is associated with an increase in the probability of moving out of poverty, relative to staying poor, of about 10 percent. Relative to other poverty status categories, households that stayed poor have smaller landholding size. In order for them to move out of poverty, they have to significantly increase their landholding size or switch to profitable off-farm activities. Tropical livestock units were also significantly associated with an increase in the odds of moving out of poverty.

In terms of agricultural potential, an additional drought day significantly decreases the probability of moving out of poverty, relative to staying poor, by 16 percent. Turning to the discussion of the factors that prevent non-poor households from falling into poverty, we find that most of the factors that can be used to lift households out of poverty can also be used to prevent the descent path, though the magnitude and significance can vary. An interesting exception is related to household size and composition. While adding a new female member is not significant in changing the odds of moving out of poverty, it significantly decreases the probability of moving into poverty by 61 percent. In contrast, adding a new male member increases the odds of falling into poverty by 126 percent. This result indicates that male and female members may have different roles in reducing poverty.

4.3.2. MOVING OUT OF AND INTO POVERTY IN THE CENTER

Table 21 presents the multinomial logit regression results for central provinces. Some of the factors discussed in the previous section also influence the probability of moving out of or into poverty in the center. In this section we focus on the discussion of the factors that differ from those in the south. In terms of demographic characteristics, households that were female-headed in 2002 but became male-headed in 2005 have increased their odds of moving out of poverty, relative to staying poor, by 790 percent. The increase in the probability of moving out of poverty is high because out of 18 households that fit in this category (become male-headed), none of them moved into poverty and 4 moved out of poverty. Becoming male-headed also decreases the likelihood of moving into poverty, relative to staying poor, by 98 percent.

In terms of change in access to public services, access to price information was highly significantly associated with both increased likelihood of moving out of poverty and decreased likelihood of moving into poverty. Change in membership of an association or access to extension was not statistically associated with poverty mobility in the center however.

The adoption of tobacco significantly increases the probabilities of moving out of poverty, relative to staying poor. Among those adopting tobacco, 62 percent (out of 59 households that fit in this category) have either stayed non-poor or moved out of poverty. Adoption of such cash crops should be promoted.

Table 21. Relative risk ratios from multinomial logit regressions: central provinces

	Moved out of povertyrelative to stayed poor				Moved into poverty relative to stayed non-poor			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Demographics								
Change in the # of members aged 0-4	0.905	1.023	1.023	1.099	0.847	1.244	1.244	1.241
Change in the # of members aged 5-14	0.641 ***	0.792	0.792	1.013	1.166	1.371	1.371	0.936
Change in the # of members aged 60 or older	0.354 *	0.558	0.558	0.870	0.551	3.466 **	3.466 **	0.813
Change in the # of male members aged 15-59	0.539 ***	0.507 ***	0.507 ***	0.913	2.211 **	2.460 *	2.460 *	1.092
Change in the # of female members aged 15-59	0.685 **	0.588 **	0.588 **	0.767 *	1.649	2.784 ***	2.784 ***	1.293
Head's years of schooling in 2002	1.333 ***	1.186 **	1.186 **	1.086	0.796 ***	0.858	0.858	0.863 **
Head's age in 2002	0.996	0.992	0.992	0.991	1.006	1.017	1.017	1.003
Change in head's gender	8.896 ***	6.294 ***	6.294 ***	1.986 *	0.019 ***	0.015 ***	0.015 ***	0.423
Labor-market participation								
Change in the # of salaried members	2.033 ***	1.892 ***	1.892 ***	1.215 **	1.091	1.582 **	1.582 **	1.198
Change in the # of self-empl. members	2.600 ***	2.117 ***	2.117 ***	1.227 ***	0.321 ***	0.213 ***	0.213 ***	0.598 ***
Access to public services								
Change in access to extension services	0.866	1.108	1.108	0.810	0.922	1.079	1.079	1.081
Change in membership to ag. association	1.666	1.779	1.779	1.104	1.225	1.328	1.328	0.768
Change in access to price info	3.276 ***	2.032 ***	2.032 ***	1.443 **	0.273 **	0.216 ***	0.216 ***	0.491 ***
Agricultural technology								
Change in the use of animal traction	4.604	3.419 **	3.419 **	2.447 ***	0.326 *	0.221 ***	0.221 ***	0.882
Change in the use of permanent labor	1.348	1.499	1.499	0.424	0.384	0.311	0.311	2.194
Change in the use of seasonal labor	6.220 ***	4.669 ***	4.669 ***	1.323	0.172 ***	0.118 ***	0.118 ***	0.477 **
HH did line sowing in 2005 (1=Yes)	1.534	1.401	1.401	0.815	1.443	0.981	0.981	0.448 **
HH did crop rotation in 2005 (1=Yes)	2.816 **	3.696 ***	3.696 ***	2.254 ***	0.778	0.565	0.565	0.710
HH used improved seeds in 2005	13.187 ***	8.322 ***	8.322 ***	2.290	0.119 **	0.245 *	0.245 *	0.722
Household assets								
Change in landholding size	0.972	0.995	0.995	0.961	0.751 ***	0.781 ***	0.781 ***	0.929
Change in tropical livestock units	1.140 ***	1.117 ***	1.117 ***	1.075 ***	0.752 ***	0.669 ***	0.669 ***	0.927 *
Cultivation of cash crops								
Change on whether the HH grows cotton	0.784	0.831	0.831	0.941	3.695	4.549	4.549	0.894
Change on whether the HH grows tobacco	34.089 ***	65.061 ***	65.061 ***	1.097	0.094	0.102 ***	0.102 ***	0.613
Agricultural potential								
Change in days of drought	1.031	1.053 ***	1.053 ***	1.012	0.714 ***	0.706 ***	0.706 ***	0.979 **
Number of observations	1149							

Notes: *** significant at .01 level; ** significant at .05 level; * significant at .10 level; District dummies are included

Sources: TIA02 & TIA05

The use of improved seeds is significantly associated with the odds of moving out of poverty, relative to staying poor. It is also associated with decreases in the probability of moving into poverty, relative to staying poor. This indicates the importance of improved agricultural technologies in increasing crop income and ultimately reducing poverty both lifting the poor out of poverty and to help the non-poor avoid falling into poverty.

The adoption of animal traction decreases the likelihood of moving into poverty, relative to staying non-poor by 67 percent. Animal traction plays an important role in expanding cultivated area. Where expansion of cultivated area is possible, adopting animal traction could have a significant impact in avoiding the non-poor from falling into poverty.

4.3.2. MOVING OUT OF AND INTO POVERTY IN THE NORTH

In this section we highlight some of the regional differences regarding the factors associated with moving out of and into poverty in northern provinces. Table 22 presents results from multinomial logit regressions for these provinces.

Membership of an agricultural association was also significantly correlated with an increase in the probability of moving out of poverty. Since northern provinces have relatively limited road infrastructure, belonging to an agricultural association may facilitate participation in the market by reducing assembly costs for potential buyers. Likewise, being a member of an agricultural association can improve the access to inputs and extension messages, which may increase the probability of moving out of poverty.

Table 22. Relative risk ratios from multinomial logit regressions: northern provinces

	Moved out of povertyrelative to stayed poor				Moved into poverty relative to stayed non-poor			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Demographics								
Change in the # of members aged 0-4	0.760 **	0.666 ***	0.666 ***	0.918	1.622 ***	1.340	1.340	1.193
Change in the # of members aged 5-14	0.597 ***	0.588 ***	0.588 ***	0.816 ***	1.401 **	1.359	1.359	1.093
Change in the # of members aged 60 or older	0.492 *	0.942	0.942	0.602 *	1.181	0.870	0.870	0.953
Change in the # of male members aged 15-59	0.537 ***	0.459 ***	0.459 ***	0.935	1.610 **	1.263	1.263	1.153
Change in the # of female members aged 15-59	0.477 ***	0.717	0.717	0.689 **	1.138	1.516	1.516	1.190
Head's years of schooling in 2002	1.372 ***	1.387 ***	1.387 ***	1.141 ***	0.812 **	0.808	0.808	0.818 ***
Head's age in 2002	0.991	0.983	0.983	0.996	0.977	0.963	0.963	0.989
Change in head's gender	1.643	1.745	1.745	1.585	0.491 *	0.596	0.596	1.105
Labor-market participation								
Change in the # of salaried members	1.742 ***	1.704 ***	1.704 ***	1.115	0.258 ***	0.228 ***	0.228 ***	0.987
Change in the # of self-empl. members	2.510 ***	2.670 ***	2.670 ***	1.397 ***	0.165 ***	0.224 ***	0.224 ***	0.722 **
Access to public services								
Change in access to extension services	1.450 *	1.130	1.130	1.079	0.515 *	0.391 *	0.391 *	0.610
Change in membership to ag. association	2.659 **	3.456 ***	3.456 ***	1.233	0.938	0.727	0.727	0.497
Change in access to price info	1.577 **	2.278 ***	2.278 ***	1.277 *	0.625	0.698	0.698	1.037
Agricultural technology								
Change in the use of permanent labor	2.352	2.232	2.232	0.683	0.301	0.068 *	0.068 *	0.709
Change in the use of seasonal labor	19.913 ***	16.440 ***	16.440 ***	1.861 ***	0.093 ***	0.075 ***	0.075 ***	0.798
HH did line sowing in 2005 (1=Yes)	3.864 ***	5.532 ***	5.532 ***	1.749 ***	0.469 *	0.439 *	0.439 *	0.455 ***
HH did crop rotation in 2005 (1=Yes)	0.859	0.651	0.651	0.841	1.495	1.478	1.478	0.863
HH used improved seeds in 2005	4.614 **	7.071 ***	7.071 ***	1.639	0.562	1.339	1.339	0.877
Household assets								
Change in landholding size	1.556 ***	1.470 ***	1.470 ***	0.990	0.497 ***	0.452 ***	0.452 ***	0.841 *
Change in tropical livestock units	1.592 ***	1.530 ***	1.530 ***	1.160 ***	0.737 *	0.863	0.863	0.987
Cultivation of cash crops								
Change on whether the HH grows cotton	1.295	1.161	1.161	1.690 *	0.982	0.822	0.822	0.620
Change on whether the HH grows tobacco	2.996 *	1.572	1.572	1.018	0.226	0.085 **	0.085 **	1.830
Agricultural potential								
Change in days of drought	0.961	0.981	0.981	0.959 ***	0.457 ***	0.566 ***	0.566 ***	1.035 *
Number of observations	1710							

Notes: *** significant at .01 level; ** significant at .05 level; * significant at .10 level; District dummies are included

Sources: TIA02 & TIA05

Access to price information was also statistically associated with a higher probability of moving out of poverty in the north (as it was in the center and south).

Similar to southern provinces, an increase in landholding size is associated with movements out of poverty. However, the marginal effect of increasing landholding size is higher in the north. While an addition hectare in the south increases the odds of moving out of poverty by 28 percent, in northern provinces it increases the probability of moving out of poverty by 56 percent.

In terms of agricultural practices, line sowing is now significantly associated with a reduction in the probability of non-poor households falling into poverty, and in lifting the poor out of poverty. Because northern provinces have relatively more rainfall, weeding practices may have a significant impact in crop income, an important source of total household income in rural Mozambique. Line sowing facilitates the weeding operation, reducing the competition between the crops and the weeds, and ultimately increasing crop production. Although line sowing may require more labor, this practice should be promoted.

Comparing results from the multinomial regressions across the three regions indicates spatial variation in the response of poverty mobility to agricultural variables. For example, mobility out of poverty is significantly and positively associated with membership of an association in the north, but not in the center or south. The use of improved seeds is also significantly and positively associated with movement out of

poverty in the north and center but not in the south. Access to price information is positively associated with movement out of poverty in all regions, but the correlation is only weakly significant in the south. In sum, poverty mobility is more responsive to agricultural variables in the center and (especially) the north compared to the south. The next section provides the poverty simulation results.

4.4. POVERTY SIMULATION

The purpose of poverty simulation is to evaluate the expected impact on poverty reduction from relatively small changes in selected variables that are amenable to change via government interventions. Though poverty simulation results do not tell us directly what policy interventions the government should consider, they allow us to identify promising areas for policy intervention based on our empirical findings.

The simulations presented in this section are based on the estimated first-difference model. By changing the values of selected explanatory variables, we obtain a new predicted change in income/AE between the two periods (2002 and 2005) for each household in the sample. The revised predicted estimate of income change is then added to initial predicted income/AE for 2002 (from equation 5) to obtain the revised predicted income/AE in 2005 as if changes in the selected explanatory variables had occurred. Lastly, we compare the poverty measures (poverty headcount, poverty gap, and squared poverty gap) using the original and modified predicted incomes in 2005.

Predicted household income/AE is a point estimate, which comes with its own forecast

error. Datt (2007) argues that even if predicted household income is above the poverty line for a given household, there is a nonzero probability that the true value of that household's income is below the poverty line, and hence, it is appropriate to treat predicted income as a stochastic variable. For the purpose of this section, to assess the relative order of magnitude of possible interventions on poverty indicators, we use point estimates only.

Our poverty simulation focuses on reducing drought vulnerability, increasing landholding size, and adoption of cash crops. Though demographic characteristics also play a key role in poverty reduction, these variables are harder to change in the short-run. For instance, though it is well documented that male-headed households tend to have higher incomes than female-headed households, it is not clear how one would induce changes in household gender. Thus, such variables were not included in the simulation exercise. Many technology variables were also excluded from the policy simulation because they were not collected in 2002.

Whereas days of drought and landholding are continuous variables, the adoption of tobacco was modeled using a dummy variable. To simulate the effect on poverty of an increase in adoption of cash crops, proxied by the cultivation of tobacco, we increase the frequency with which the dummy variable takes on the value 1 as opposed to 0. New adopters in the sample were identified using a random process to achieve a predetermined regional adoption rate. Since the tobacco companies that smallholders depend on for

access to specialized inputs only operate in selected areas, adoption is restricted to districts where the crop was already grown in either 2002 or 2005.

4.4.1 REDUCTION IN DROUGHT VULNERABILITY

Table 23 shows the effect of reducing drought vulnerability on poverty incidence in rural Mozambique. In general there were more days of drought in 2005 than in 2002, but the increase in days of drought was not uniform across the country. In addition, in central provinces days of drought did not differ significantly between the two periods, and thus we refrain from simulating the impact of reducing drought vulnerability in that region.

Table 23. Effect of reducing days of drought on poverty indicators

Reduction in days of drought	Percent change in poverty indicator								
	National			North			South		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
1	-0.3	-1.1	-1.6	-0.3	-1.4	-2.0	-0.3	-1.3	-2.0
2	-0.6	-2.2	-3.1	-0.9	-2.8	-4.0	-0.3	-2.7	-3.9
3	-1.1	-3.4	-4.6	-1.6	-4.2	-5.9	-0.5	-4.1	-5.8
4	-1.4	-4.5	-6.1	-2.1	-5.6	-7.9	-0.9	-5.4	-7.8
5	-1.8	-5.6	-7.6	-2.7	-7.1	-9.8	-1.2	-6.8	-9.7
6	-2.2	-6.7	-9.1	-3.1	-8.5	-11.7	-1.6	-8.3	-11.6

Notes: P_0 - poverty headcount; P_1 - poverty gap; P_2 - squared poverty gap
Change in poverty headcount calculated as simulated poverty headcount minus poverty headcount in 2005
P_1 and P_2 calculated as 100*(simulated poverty indicator - poverty indicator in 2005)/poverty indicator in 2005
Sources: TIA02 & TIA05

At the national level, poverty headcount, poverty gap and squared poverty gap would have been lower in 2005 if rural households had not experienced significant increases in drought days. If the increase in drought between 2002 and 2005 had been 6 days shorter, the national poverty headcount would have been about 2 percentage points lower. The corresponding reduction in poverty gap and squared poverty gap would have been 6.7 and 9.1 percent, respectively. The reduction in poverty headcount would have been

greater in northern region than in the south, which reflects the fact that households in the former region are more dependent on crop production, and hence more vulnerable to drought than households in the south. Therefore, although the southern region usually receives less rainfall than the northern region, because the latter relies relatively more on agricultural income, a reduction in drought vulnerability among households in the northern region will have a relatively higher impact on poverty headcount.

The government already recognizes the importance of small-scale irrigation as a means to combat drought, and numerous projects are underway. But irrigation tends to be very costly and hence the proportion of farmers who have access to irrigation technology remains very low. Other countries in the region facing similar challenges (e.g., Zambia, Malawi) are actively testing conservation agriculture practices, but little assessment appears to have been conducted in Mozambique to date. In the medium-term, genetically modified drought-tolerant varieties of maize will become available. It will be very important for the government to have the necessary policies in place to allow the testing of such genetically modified drought tolerant varieties. Thorough study of each of these options is needed as they could be technically or economically unfeasible in some regions.

4.4.2 INCREASE IN LANDHOLDING SIZE

In this section we evaluate the expected impact on poverty resulting from simulated increases in landholding size. Table 24 shows the impact of increases in landholding size in 2005 by 10 percent. At the national level, poverty headcount would decrease by almost

1 percentage point. The effect of increasing landholding size is greatest in the north, followed by the central provinces. One possible reason for the smaller marginal effect of increasing landholding size in the south is its lower dependence on crop income, relative to the other regions. The induced increase in landholding size by 10 percent would also result in a decline in both poverty gap and the squared poverty gap. Poverty depth would decrease by 1.8 percent and poverty severity would decrease by 2.2 percent in rural Mozambique.

Table 24. Effect of increasing landholding size (ha) on poverty indicators

% Increase in landholding in 2005	Percent change in poverty indicator											
	National			North			Center			South		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
10	-0.8	-1.8	-2.2	-1.1	-2.2	-2.8	-0.7	-1.9	-2.3	-0.1	-0.3	-0.4

Notes: P_0 - poverty headcount; P_1 - poverty gap; P_2 - squared poverty gap
Change in poverty headcount calculated as simulated poverty headcount minus poverty headcount in 2005
P1 and P2 calculated as 100*(simulated poverty indicator - poverty indicator in 2005)/poverty indicator in 2005
Sources: TIA02 & TIA05

The impact of increasing landholding size on poverty headcount seems to be low. The simulated effect of increasing landholding size may reflect drought conditions in 2005. In a year of better rainfall the effect of increasing landholding size would likely be greater. In addition, we are simulating for increase in landholding *ceteris paribus*. Increases in landholdings are therefore a necessary but not sufficient condition to reduce rural poverty. Moreover, because poorer households have relatively small landholdings, a 10 percent increase may not be significant in lifting them out of poverty.

Several studies have acknowledged the correlation between income and landholdings in Mozambique at the national level (Tschirley and Weber, 1994; Jayne *et al.*, 2003; Boughton *et al.*, 2006; Boughton *et al.*, 2007; Walker *et al.*, 2004). But increases in

landholding size are occurring at a slow pace for two possible reasons. First, there are opportunity costs involved in increasing landholding size (labor, access to basic infrastructure and services, and others). For example, some households may have to cultivate more land outside or away from their villages. If new land is available only outside the village this implies additional time to walk to the field for cultivation. In the case where access to additional land is constrained in the village, leaving may not be feasible as the new location may not have the basic infrastructure such as wells, schools, and access to health services.

Second, it may be more difficult to expand landholdings in areas located close to cities. Land tends to be scarcer in these areas, and the alternative for rural households dwelling in such locations could be either switching from cultivation of staple crops to higher value crops or moving into productive non-farm activities. The cultivation of high value crops is actually occurring in some areas close to cities. For example, in peripheral and rural areas close to Maputo and Beira (the two largest urban centers in Mozambique) there are many households growing vegetables for sale.

In areas where additional land is available for cultivation, labor for weeding is well known to be a major constraint. One technology that could address this constraint is herbicides. With the exception of cotton (Strasberg, 1994), there are no studies of the profitability of herbicide use in Mozambique. Boughton *et al.*(2007) report that the cotton company in Cabo Delgado province has been piloting the use of low volume herbicides with cotton growers, using the same application equipment already used for

insecticide treatments. The response of farmers has been very enthusiastic despite the additional cost of the chemical as it enables them to weed both their cotton and food crops on time. Expansion in the use of herbicide, if profitable, would still be constrained outside cotton or tobacco contract farming arrangements by the lack of an input distribution network and lack of access to credit.

4.4.3 ADOPTION OF CASH CROPS

This section presents the effect of adopting cash crops to poverty reduction in rural Mozambique using the example of tobacco in central provinces. Simulation of cotton was not included because its adoption was not significant in increasing changes in household income per adult equivalent. Simulation of tobacco in southern provinces was not included because very few households grow this crop in the south. Although a significant number of households grow tobacco in the north, its impact was not significant in increasing household income/AE in northern provinces, and hence, we do not include the north.

Table 25 shows the impact of a 10 percent adoption of tobacco in central provinces. Poverty headcount in the center would have declined by almost 3 percent. The corresponding reduction in poverty gap and squared poverty gap would have been 4.5 and 4.9 percent, respectively.

Table 25. The effect of adoption of cash crops on poverty indicators

	Percent change in poverty indicator		
	Center		
	P_0	P_1	P_2
10% adoption in the center	-2.98	-4.50	-4.87

Notes: P_0 - poverty headcount; P_1 - poverty gap; P_2 - squared poverty gap

Change in poverty headcount calculated as simulated poverty headcount minus poverty headcount in 2005

P1 and P2 calculated as 100*(simulated poverty indicator - poverty indicator in 2005)/poverty indicator in 2005

Sources: TIA02 & TIA05

This results shows that cash crops can potentially have an important impact on poverty reduction. Therefore, to achieve this level of impact in a broader scale, we need to understand the reasons why cotton is not contributing to poverty reduction, and why tobacco is not contributing to poverty reduction in the north, and take counteractive measures. The next chapter summarizes key results.

CHAPTER V SUMMARY RESULTS

The analysis presented in this paper is based on a nationally representative panel data set from Mozambique, covering the period 2002-05. The results presented were influenced by occurrence of a widespread drought in the second period. The first question addressed relates to changes in poverty and income distribution. Though mean household income per adult equivalent increased between 2002 and 2005, the lowest two income quintiles experienced a decrease in household income. Consequently, median household income per adult equivalent has decreased between 2002 and 2005, and the distribution of income has become more unequal. However, poor households are not necessarily doomed to stay at the bottom of the distribution as some of the poorest households in 2002 moved to the highest income quintile in 2005. Although at the national level poverty headcount has increased, we cannot unambiguously say that poverty incidence was higher in the second period. In terms of poverty gap and squared poverty gap, at the national level we can unambiguously say that both the depth and severity of poverty was higher in the second period.

Poverty in rural Mozambique has various dimensions. In terms of a geographical dimension, Nampula province is an area of major concern. Nampula is one of the most populated provinces, and despite its agricultural potential, it is one in which the percentage of households moving out of poverty is among the lowest, and the percentage of those moving into poverty is among the highest. Overall, poverty incidence has slightly increased as the percentage of households moving into poverty is greater than the

percentage of households moving out of poverty. In Sofala province by contrast, poverty headcount, poverty gap and squared poverty gap have significantly decreased.

The second question addressed in this paper was to understand the factors underlying household income change. Adoption of improved agricultural technologies and cash crops is associated with increases in household income, especially in the center and north. These findings are consistent with other studies (Walker *et al.*, 2006; Walker *et al.*, 2004; Boughton *et al.*, 2006), where the role of agriculture in poverty reduction is acknowledged. In addition to adoption of improved technologies, diversification of income sources is also associated with changes in household income. For example, in Sofala province, many household members have engaged in self-employment activities, the use of animal traction has increased, the average cattle herd size has almost doubled, more households have access to extension services and price information, and change in days of drought was not significant. The combination of all these factors resulted in increases in household income, and thus, decreases in poverty incidence, poverty gap, and severity.

The widespread drought in 2005, particularly in northern and southern Mozambique, has also contributed to household income change. Households experiencing drought had relatively lower crop production, which contributed to a decline in total household income in cases where nonfarm income opportunities were insufficient to compensate. This result indicates the importance of diversification of income sources, especially in predominantly rainfed agricultural systems, which is the case of rural Mozambique. On

the other hand, this result implies that reduction in the vulnerability of agriculture to drought will lead to increases in household income, and ultimately, poverty reduction.

The third question addressed factors associated with moving out of or into poverty in the short run. In terms of the demographic dimension of poverty, we find that the percentage of households remaining poor is higher among female-headed households. Male-headed households are also more likely to have moved out of poverty than female-headed households. With the exception of those moving out of poverty, on average the household size has increased for all other poverty status categories.

Given the widespread drought in 2005, it is not surprising that off-farm income played an important role in changes in household poverty status. Households staying poor were able to increase their income from all off-farm activities, but their increase was not significant enough to lift them out of poverty. Households moving out of poverty had a large percentage increase from almost all off-farm activities, except from the extraction of forestry and fauna resources with a high return (charcoal production and fishing). In contrast, households moving into poverty had decreases from all off-farm sources. Thus, diversification in non-farm income opportunities is important in reducing poverty in rural Mozambique.

In terms of assets, we find that households staying poor started out with smaller landholdings. Landholding size has increased for all poverty status categories except among households moving into poverty. These households started out with more land

than the poor in 2002, but their average landholding size was smaller than of those who stayed non-poor.

In terms of agricultural practices and access to services, two distinct patterns are noteworthy. First, the use of fertilizers, pesticides, and animal traction has increased among households moving out of poverty. In contrast, households moving into poverty have experienced a decrease in the use fertilizers, pesticides, and animal traction. Much of the change in fertilizer and pesticide use is likely associated with adoption or dis-adoption of tobacco and cotton. Although the percentage of households using animal traction has decreased at the national level, households moving out of poverty were able to maintain (or increase) its use, whereas those moving into poverty significantly disadopted animal traction use. The use of seed and improved cultivation practices is higher among the non-poor, and reduction in the use of such technologies is correlated with moving into poverty. Second, there are notable regional differences in the response of poverty mobility to access to public services and use of improved agricultural practices.

Most of the results show that factors associated with movements out of poverty are the same as those associated with movements into poverty. An exception is the use of animal traction in central provinces, and adoption of tobacco in central and northern provinces. Animal traction is used to cultivate relatively large areas and households cultivating such areas are more likely to be non-poor. Thus, adoption of animal traction is likely to be more effective in helping the non-poor avoid falling into poverty than in lifting the poor

out of poverty. The marginal effect of cultivating tobacco is significant in increasing household income among the poor, but not in avoiding non-poor households from falling into poverty.

For a country like Mozambique, where the agriculture is dependent on erratic rainfall, the occurrence of drought is one of the major limitations. The simulation results show that reducing drought vulnerability has a significant impact in poverty reduction. Possible interventions include the adoption of drought-tolerant technologies, such as the adoption of drought-tolerant seeds or conservation agriculture, or even the development of irrigation schemes. However, additional studies on the costs and benefits of each of these opportunities are necessary.

Simulation of the adoption of tobacco in central provinces resulted in significant decreases in poverty headcount. At present, expansion of area under cash crops is limited to zones where tobacco or cotton companies operate. Similarly, animal traction is concentrated in the center and south. Broadening the poverty reduction potential of cash crops will require a more detailed study of the potential for adoption in new areas. The results also show that tobacco and cotton were not significant in reducing poverty in the north, which has to do with disadoption in 2005 and the relatively low performance of cotton and tobacco contract farming companies in northern provinces.

In sum, this paper presented empirical evidence regarding the vulnerability of rural households to occurrence of drought and its impact on poverty. It also showed the role of

off-farm income both in lifting the poor out of poverty and in the prevention of a descent movement into poverty. Reducing drought vulnerability and promoting off-farm employment opportunities will significantly reduce poverty in rural Mozambique. Where expansion of cultivated area is possible, increasing landholding size can significantly reduce poverty.

APPENDICES

Appendix A-1. Construction of Price Inflators for TIA02-TIA05 panel income analysis (Mather *et al.*, forthcoming)

Summary: We use *IAF* 2002/03 consumption quantities (flexible adjusted) from the food consumption basket of each *IAF* poverty region. These quantities are valued using 2002 *SIMA* retail prices, then the basket is revalued with 2005 *SIMA* prices to update the cost of an identical (fixed) consumption basket. The consumption quantities are therefore the weights for the commodity prices. The inflators which we create are fixed because the weights are not allowed to change over time (relative to flexible inflators, fixed inflators which will tend to overestimate inflation, thus underestimating growth).

For commodity 1 (maize):

Q1j = grams consumed/day of commodity maize from *IAF* 2002/03 food basket for region j

P1j = *SIMA* 2001/02 rural retail market price/gram for region j

The share of this commodity's value in the total value of consumption (at the poverty line) is = $Q1j*P1j / \sum_i (Qij*Pij)$ – where i is commodity (from 1 to n) and j is the province or poverty region. The quantities in a given region's basket varies by *IAF* poverty region (some regions contain two province), though the prices vary by province in some cases.

Step 1: Convert *IAF02* quantities consumption of quantities with *SIMA* price data covered

by *SIMA* into quantities covered by *SIMA* (where possible).

Step 2: for *IAF02* commodities for which we have *SIMA* price data, revalue the commodity basket using *SIMA* 2002 prices, computing $P1j^{02}*Q1j^{02}$ for 2002, where Pij^{02} is the annual average *SIMA* retail price/gram for commodity i for that province j (or region if a price for that province is not available). The sum value of this subset of *IAF* basket commodities for a given region j is $\sum_i (Pij^{02}*Qij^{02})$. This is the 'cost of a consumption basket in 2002, for province j'.

Step 3: for that same subset of commodities, compute $Pij^{05}*Qij^{02}$ for 2005, where Pij^{05} is the annual average *SIMA* retail price/gram for commodity i for that province j (or region if a price for that province is not available). The sum value of these commodities is $\sum_i (Pij^{05}*Qij^{02})$. This is the 'cost of a consumption basket in 2005, for province j'.

Step 4: compute the ratio $\sum_i (Pij^{05}*Qij^{02}) / \sum_i (Pij^{02}*Qij^{02})$; this is our price inflator (PIj) for province j. If we want our panel values to be in 2002 prices, we divide *TIA05* income by PIj. If we want to the panel values to be in 2005 prices, we multiply *TIA02* income by PIj.

Computing the annual average *SIMA* retail price

We compute an annual average *SIMA* rural retail price (nominal) for 2001/2, and one for 2004/5, for each province (or *IAF* poverty region). *IAF* consumption quantities and prices reflect the period of *IAF* implementation July 2002 –June 2003. The first wave of the *TIA*

panel was implemented in the fall of 2002, and collected recall data for the period October 2001 – September 2002 (the 2001/02 agricultural year). The second wave was implemented in the fall of 2005, and collected recall data for the period October 2004 – September 2005 (the 2004/05 agricultural year). Since we want to control for price inflation between the *TIA* panel surveys, we compute an annual price where the year is defined as October-September (Oct 2001- Sept 2002; Oct 2004 - Sept 2005) to correspond with the *TIA* recall periods.

SIMA collects weekly price data from 3 traders in a given market. For the given commodity and rural retail market, we first take the mean of the 3 trader prices for a given week at that market. Second, we compute the median (nominal) price for each quarter of the year for each market (the 'first quarter' of *TIA* recall is October-December). Third, if there is more than one market in a given region, we compute the mean quarterly price across the markets in that region. Fourth, we compute the annual price as the mean of the quarterly prices for that commodity in the given region. Computing quarterly prices (step 2) before the annual price ensures that we aren't weighting too heavily quarters of the year in which there happen to be more observations. If a province does not have price observations for a given commodity, we use the price from the neighboring '*IAF* poverty region' province (for example, Cabo Delgado and Niassa are in the same *IAF* poverty region).

There are several aspects of this method which are less than ideal, but which we still find preferable to using the INE urban CPI from Maputo, Beira, and Nampula. First, the *SIMA*

prices we use do not correspond temporally to the reported quantities consumed in *IAF* given that the *IAF* 2002/03 survey covers a different period of time relative to *TIA* 2001/02. If we were to use prices from the *IAF* period then we might underestimate price inflation from 2002 to 2005, since *IAF* prices represent a period which occurred nearly a year after the *TIA02* recall period. Second, while the *SIMA* prices are from the same region as the *IAF* quantities, they technically do not correspond spatially to the *IAF* quantities. We choose not to update the *IAF* food basket values using *SIMA* prices only for 2005, since the SIMA and *IAF* prices (even if they were for the same year, which they are not) would likely be somewhat different given differences in the location and method of price reporting between *IAF* and *SIMA*. *IAF* prices are derived from the reported 'retail value' of retail-purchased or home consumption of commodities. MNF analysts bounded these household prices by price observations from the nearest village market taken at the same time as the household survey. By contrast, while there are many fewer observations of *SIMA* prices per province (only 1-3 rural markets per province), the *SIMA* price data itself is likely to have less measurement error given that it is measured directly by *SIMA* staff as well as recollection collected using *SIMA*-standardized methods (i.e. standard containers) to ensure accurate quantity conversion (to a kilogram price). This rationale is not meant to criticize *IAF* price data, but rather simply to demonstrate why we chose not to value the *IAF* 2002 quantity using an *IAF* price for 2002 and a *SIMA* price for 2005.

To ensure that we are able to capture price seasonality throughout the year, we only use data from *SIMA* markets which have recorded at least one price for each quarter of the year (this is the case of the majority of *SIMA* markets). If a market is missing just one

quarter out of the four for a given year, we use price inflation by quarter for that product in that region to impute the missing price for the product/market in that quarter. For example, if a Niassa rural market is missing a maize price for the 3rd quarter, we use the average price inflation in the north for maize between the 2nd and 3rd quarter to inflate the observed Niassa rural market maize price in the 2nd quarter and thus impute a 3rd quarter price. In all but one or two cases, this was the only price missing for the 8 quarters of price data (i.e. the two years of the *TIA* panel), and a majority of markets had complete price data for all 4 quarters for both years. As follows are the number of *SIMA* rural markets used relative to those with incomplete price data: (number of markets with one quarter missing/number of markets used) = maize in grain (1/7), maize flour (2/6), cowpea (2/6), common beans (2/9), rice (2/8), cooking oil (1/6), peanuts – small seeds (2/5), peanuts – large seeds (3/5), and sugar (2/6).

IAF basket commodities used in our baskets

We use the 2002/03 adjusted flexible quantities of each commodity in the *IAF* food baskets for each *IAF* poverty region (obtained from MPF, 2004 via Channing Arndt), and use only those commodities for which we can match a *SIMA* price (or an imputed price, in the case of sweet potatoes).

IAF commodity name = SIMA commodity name

Milho branca em grao = Grao de milho branco nacional

Farinha de milho branco com farelo, nacional = Farinha de milho branco nacional com farelo

Farinha de mandioca = (converted to fresca)

Mandioca fresca = mandioca fresca

Feijao nhemba = feijao nhemba

Feijao manteiga = feijao manteiga nacional

Arroz corrente = arroz corrente

Oleo = Oleo alg/avul

Amendoim pequena = amendoim pequena

Acucar nacional = acucar castanho nacional

Batata doce = *imputed retail price*

IAF consumption baskets often include consumption of the same commodity in different states/forms (i.e., flour, with husks, grain, dried/fresh, etc). Since we tend to only have *SIMA* price data for one of the product forms, we convert the *IAF* quantities of some commodities to the form for which we have *SIMA* price data, using *TIA* commodity conversion factors as constructed for *TIA02*.

SIMA 's coverage of cassava flour and fresh cassava is geographically very sparse (we only have 4 quarters of price data for Mocuba). However, we have a considerable number of farmgate cassava prices from *TIA* across all regions. We compute the marketing margin (%) between the *SIMA* flour price and the *TIA* farmgate cassava price for Mocuba. We then apply this marketing margin to the *TIA* farmgate cassava price data by region to impute retail cassava prices for each region.

SIMA does not collect price data for every commodity in the *IAF* consumption baskets. Most of these commodities we simply must drop from the *IAF* consumption basket. Column F in Table A-2 shows how much of the total *IAF* expenditure basket for a given region is covered by the commodities in our adjusted baskets. However, for sweet potato, we impute a 2002 retail price by applying the cassava marketing margin to the *TIA* farmgate price data on sweet potato.

Table A 1. Poverty gap by province and year

Province	Actual poverty line		Decrease poverty line by 20%		Decrease poverty line by 50%		Increase poverty line by 20%		Increase poverty line by 50%	
	2002	2005	2002	2005	2002	2005	2002	2005	2002	2005
Niassa	36.8	36.4	26.5	26.8	7.8	9.4	45.0	44.1	54.4	53.1
Cabo Delgado	48.8	39.4	38.2	30.2	16.0	12.8	56.8	47.0	65.2	55.8
Nampula	31.5	47.1	21.2	37.5	6.2	18.1	40.5	54.4	50.7	62.7
Zambézia	38.3	45.8	28.9	35.9	12.5	16.0	45.9	53.2	54.6	61.3
Tete	38.3	47.9	30.9	40.3	16.1	23.5	44.5	53.8	52.4	60.4
Manica	47.5	47.7	38.9	39.8	21.0	24.4	54.1	54.1	61.3	61.2
Sofala	41.2	23.0	32.0	16.1	15.1	5.2	48.6	29.0	57.2	37.0
Inhambane	41.3	37.2	31.7	28.0	13.3	12.3	48.9	45.2	57.7	54.2
Gaza	57.2	49.3	48.0	39.6	26.5	18.9	63.6	56.8	70.3	64.7
Maputo	51.6	56.6	42.8	47.7	22.5	28.1	58.3	62.9	65.7	69.5
National	40.6	43.7	31.1	34.6	13.6	16.6	48.2	50.9	56.9	59.0

Source: TIA02 & TIA05

Table A 2. Squared poverty gap by province and year

Province	Actual poverty line		Decrease poverty line by 20%		Decrease poverty line by 50%		Increase poverty line by 20%		Increase poverty line by 50%	
	2002	2005	2002	2005	2002	2005	2002	2005	2002	2005
Niassa	19.1	19.8	11.9	13.0	2.6	3.6	25.8	26.1	34.6	34.4
Cabo Delgado	28.4	22.8	19.7	15.9	6.1	5.4	36.0	29.1	45.1	37.3
Nampula	15.5	28.6	9.3	20.7	2.1	7.8	21.9	35.5	30.6	43.9
Zambézia	21.9	27.1	15.2	19.1	5.3	6.7	28.1	34.0	36.2	42.5
Tete	24.2	31.9	18.2	24.9	8.6	12.1	29.5	37.8	36.4	44.8
Manica	30.5	32.2	23.1	25.5	10.5	13.8	36.7	38.0	44.4	45.2
Sofala	24.6	11.9	17.6	7.5	6.8	2.4	30.9	16.3	38.9	22.4
Inhambane	23.8	21.4	16.4	14.9	5.7	5.4	30.4	27.5	38.7	35.7
Gaza	37.4	30.3	28.6	22.1	12.5	8.5	44.5	37.3	52.7	45.9
Maputo	33.1	37.9	24.9	29.7	10.3	14.3	39.8	44.7	48.0	52.5
National	23.5	26.5	16.4	19.2	5.9	7.5	30.0	32.9	38.3	41.0

Source: TIA02 & TIA05

Table A 3. List of non-farm income generating activities

Category	Activities
Unskilled agricultural wage	Unskilled agricultural wage from small and large farms
Unskilled non-agricultural wage	Unskilled non-agricultural wage
Skilled non-agricultural wage	Skilled or specialized wage labor and mining
Extraction of forestry or fauna products with low return	Cut firewood, sticks, palm tree leaves, and grass, collect honey and bush fruits, and hunting
Extraction of forestry or fauna products with high return	Charcoal production and fishing
Other self-employment activities with low return	Handicraft, carpentry, cloth making, bicycle and radio repairing, blacksmith, brick or concrete block production
Other self-employment activities with high return	Home-made beverages, purchase and sale of beverages, food and non-food products, purchase and sale of livestock, agro-processing and milling activities

Source: TIA02 & TIA05

REFERENCES

Alderman, Harold. (1992). *Incomes and Food Security in Ghana.* CFNPP Working Paper N° 26. Ithaca, NY.

Arndt, Channing and Kenneth Simler. (2007). Estimating Utility – Consistency Poverty Lines with Applications to Egypt and Mozambique. Paper presented at the conference on Economic Development in Africa, Centre for the Study of African Economies, University of Oxford.

Benfica, Rui. (2006). An Analysis Of Income Poverty Effects in Cash Cropping Economies in Rural Mozambique: Blending Econometric and Economy-Wide Models. PhD Dissertation, Michigan State University, East Lansing, Michigan

Booysen, F., van der Berg, S., Burger, R., von Maltitz, M., and Gideon du Rand. (2005). Using an Asset Index to Assess Trends in Poverty in Seven Sub-Saharan African Countries. Presented at the International Conference *in* The many dimensions of poverty. Brasilia, Brazil 29-31 August 2005.

Boughton, Duncan, David Mather, David L Tschirley, Thomas Walker, and Ellen Payongayong. (2005). Pro-Poor Rural Economic Growth for Post-Civil War Recovery: Myth or Reality in Mozambique? Accepted as a poster paper for the 26th International Association of Agricultural Economics Meeting, Brisbane, August 2006.

Boughton, D., Mather, D., Tschirley, D., Walker, T., Cunguara, B., and Ellen Payongayong. (2006). *Changes in Rural Household Income Patterns in Mozambique 1996-2002 and Implications for Agriculture's Contribution to Poverty Reduction.* MINAG Research Report No.61E. Maputo: Ministry of Agriculture

Boughton, Duncan, David Mather, Christopher B. Barrett, Rui Benfica, Danilo Abdula, David Tschirley and Benedito Cunguara. (2007). Market Participation by Rural Households in a Low-Income Country: An Asset-Based Approach Applied to Mozambique. *Faith and Economics* Vol 50:64-101.

Chaudhuri, S. and Martin Ravallion. (1994). How Well do Static Welfare Indicators Identify the Chronically Poor. *Journal of Public Economics* 53(3): 367-394.

Christiaensen, Luc , Lionel Demery and Stefano Paternostro. (2002). Growth, Distribution and Poverty in Africa: Messages from the 1990s. The World Bank, Washington D.C.

Datt, Gaurav. (2007). Simple Formulae for Predicting Poverty Measures from Regression Models of Household Living Standards. World Bank

Datt, G., Simler, K., Mukherjee, S., and Gabriel Dava. (2000). *Determinants of Poverty in Mozambique: 1996 – 97.* IFPRI Food Consumption and Nutrition Division Working Paper No.78, Washington DC.

Datt, G. and Dean Jolliffe. (2005). Poverty in Egypt: Modeling and Policy Simulations. *Economic Development and Cultural Change* 53(2): 327–346.

Davidson, Russell and Jean-Yves Duclos. (2006). *Testing for Restricted Stochastic Dominance*. Departmental Working Papers 2006-20, McGill University, Department of Economics.

Davidson, Russell and Jean-Yves Duclos. (2000). Statistical Inference for Stochastic Dominance and for the Measurement of Poverty and Inequality. *Econometrica* 68(6): 1435-1464.

Deaton, A. (1997). *The Analysis of Household Surveys*. Washington, D.C.: World Bank.

Dercon, S. (2002). Income Risk, Coping Strategies and Safety Nets. *World Bank Research Observer* 17(2): 141-166.

Duclos, Jean-Yves, Abdelkrim Araaryand, and John Giles. (2006). *Chronic and Transient Poverty: Measurement and Estimation, with Evidence from China.* ECINEQ Working Paper 2006-35.

El-laithy, H., M. Lokshin, and Arup Banerji. (2003). *Poverty and Economic Growth in Egypt 1995-2000.* World Bank Policy Research Working Paper 3068.

Fox, Louise, Elena Bardasi, and Katleen Van den Broeck. (2005). *Poverty in Mozambique: Unraveling Changes and Determinants.* Africa Region Working Paper Series No.87.

Government of Mozambique. (2006). Council of Ministers. *Poverty Reduction Strategy Paper II.* Maputo.

Government of Mozambique. (2001). Council of Ministers. *Poverty Reduction Strategy Paper I.* Maputo.

Gradin, C., Olga Cantó, and Coral del Rio. (2004). Inequality, Poverty and Mobility: Choosing Income or Consumption as Welfare Indicators. Paper Prepared for the 28th General Conference of The International Association for Research in Income and Wealth, Cork, Ireland, August 22 – 28, 2004.

Grootaert, C., Ravi Kanbur, and Gi-Taik Oh. (1995). *Why Some People Escape from Poverty and Others Don't: An African Case Study.* The World Bank Policy Research Working Paper 1499.

Hsiao, Cheng. (2005). *Why Panel Data.* Institute for Economic Policy Research Working Paper No. 05.33. University of Southern California.

Hulme, David. (2003). Conceptualizing Chronic Poverty. *World Development* 31(3): 403-423.

Jalan, Jyotsna and Martin Ravallion. (1998). Transient Poverty in Post-Reform Rural China. *Journal of Comparative Economics* 26(2): 338-357.

James, R., Arndt, C., and Kenneth Simler. (2005). *Has Economic Growth in Mozambique Been Pro-Poor?* IFPRI Food Consumption and Nutrition Division Working Paper No.202, Washington DC.

Jayne, T.S, Takashi Yamano, Michael Weber, David Tschirley, Rui Benfica, David Neven, Anthony Chapoto, and Ballard Zulu. (2003). *Smallholder Income and Land Distribution in Africa: Implications for Poverty Reduction Strategies.* MSU International Development Paper N°24.

Jha, Raghbendra and Anurag Sharma. (2003). *The Spatial Distribution of Rural Poverty in the Last Three Quinquennial Rounds of NSS.* Australian National University Working Paper. Canberra, Australia

Kakwani, Nanak. (1980). On a Class of Poverty Measures. *Econometrica* 48(2): 437-446.

Lipton, M. and M. Ravallion. (1995). "Poverty and Policy", Chapter 41 in Behrman, J. and T.N. Srinivasan, *Handbook of Development Economics*, vol. 3A, Elsevier Science B.V., pp. 2551-2657.

Long, J. S., and J. Freese. (2006). Regression Models for Categorical Dependent Variables Using Stata. Stata Press.

MADER. (2002). Relatório Geral do TIA. Maputo, Mozambique: Ministry of Agriculture and Rural Development.

Maluccio, John. (2000). *Attrition in the Kwazulu Natal Income Dynamics Study 1993 – 1998*. IFPRI Food Consumption and Nutrition Division Discussion Paper No.85, Washington DC.

Marrule, Higino. (1998). Land-Poor in a "Land-Abundant" Setting: Unraveling a Paradox in Mozambique. Masters Plan B Paper. East Lansing: Michigan State University

Mather, David and Cynthia Donovan. (Forthcoming). The Impacts of Prime-age Adult Mortality on Rural Household Income, Assets, and Poverty in Mozambique.

Mather, David, Ellen Payongayong, and Benedito Cunguara . (Forthcoming). Household Income and Asset Dynamics in Rural Mozambique, 2002-2005.

McCulloch, Neil, and Bob Baulch. (1997). *Distinguishing the Chronically from the Transitory Poor: Evidence from Rural Pakistan.* IDS Working Paper 97.

McKay, Andrew and David Lawson. (2002). *Chronic Poverty: A Review of Current Quantitative Evidence Chronic Poverty*. Research Centre Working Paper No 15.

Ministério da Agricultura e Desenvolvimento Rural (MADER). (2002). Trabalho de Inquérito Agrícola 2002. Departamento de Estatística, Direcção de Economia, MADER, República de Moçambique, Maputo, Moçambique.

Ministério da Agricultura e Desenvolvimento Rural (MADER). (2003). Trabalho de Inquérito Agrícola 2003. Departamento de Estatística, Direcção de Economia, MADER, República de Moçambique, Maputo, Moçambique.

Ministério da Agricultura (MINAG). (2005). Trabalho de Inquérito Agrícola 2005. Departamento de Estatística, Direcção de Economia, MADER, República de Moçambique, Maputo, Moçambique.

MPF/UEM/IFPRI (Mozambique Ministry of Planning and Finance/Eduardo Mondlane University/International Food Policy Research Institute). (2004). Poverty and well-being in Mozambique: The Second National Assessment (2002-2003). Maputo.

Ravallion, Martin. (1992). *Poverty Comparisons: A Guide to Concepts and Methods.* LSMS Working Paper 88. The World Bank.

Ravallion, Martin. (1996). Issues in Measuring and Modeling Poverty. *Economic Journal* 106 (438): 1328-1343.

Ravallion, Martin and M. Lokshin. (2003). *On the Utility Consistency of Poverty Lines.* World Bank Policy Research Working Paper No. 3157. Washington, D.C.

Resnick, Danielle and Regina Birner. (2006). *Does Good Governance Contribute to Pro-Poor Growth: A Review of the Evidence from Cross-Country Studies.* IFPRI Development Strategy and Governance Division Discussion Paper No. 30.

Simkins, Charles. (2004). *What Happened to the Distribution of Income in South Africa Between 1995 And 2001?* University of the Witwatersrand.

Slesnick, D. (1993). Gaining Ground: Poverty in the Postwar United States. *Journal of Political Economics* 101(1): 1-38.

Tarp, F., Simler, K., Matusse, C., Heltberg, R., and Gabriel Dava. (2002). *The Robustness of Poverty Profiles Reconsidered.* Food Consumption and Nutrition Division of the International Food Policy Research Institute Discussion Paper No. 124.

Thorbecke, Erik. (2005). *Multi-Dimensional Poverty: Conceptual and Measurement Issues.* Paper prepared for The Many Dimensions of Poverty International Conference, UNDP International Poverty Centre, Brasilia, August 29-31, 2005.

Trzcinski, E. and Randolph, S. (1991). Human Capital Investment and Relative Earnings Mobility: The Role of Education, Training, Migration, and Job Search. *Economic Development and Cultural Change* 40(1): 153-168.

Tschirley, David, Colin Poulton and Duncan Boughton. (2006). The Many Paths of Cotton Reform in Eastern and Southern Africa: Lessons from a Decade of Experience. International Development Working Paper 88. East Lansing: Michigan State University.

Tschirley, David and Rui Benfica. (2001). *Smallholder Agriculture, Wage Labour, and Rural Poverty Alleviation in Mozambique: What does the Evidence Tell Us?* MINAG Research Report No. 41. Maputo: Ministry of Agriculture.

Tschirley, David and Michael Weber. (1994). Food Security Strategies under Extremely Adverse Conditions: The Determinants of Household Income and Consumption in Rural Mozambique. *World Development* 42(2): 159-173.

Verpoorten, Marijke. (2003) *The Determinants of Income Mobility in Rwanda, 1990 – 2002.* KULeuven Working Paper.

Walker, T., D. Tschirley, J. Low, M.Tanque, D. Boughton, E. Payongayong, and M. Weber. (2004). *Determinants of Rural Income, Poverty and Perceived Well-Being in Mozambique in 2001-2002.* MINAG Research Report No. 57E. Maputo: Ministry of Agriculture

Walker, T., D. Boughton, D. Tschirley, R. Pitoro, and Alda Tomo. (2006). Using Rural Household Income Survey Data to Inform Poverty Analysis: An Example from Mozambique. Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006.

Wooldridge, J. (2002a). *Introductory Econometrics: A Modern Approach.* South Western College Publishing.

Wooldridge, J. W. (2002b). *Econometric Analysis of Cross Section and Panel Data.* Cambridge, Massachusetts: The MIT Press.