MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT

Economics Directorate

Research Paper Series

DETERMINANTS OF RURAL INCOME, POVERTY, AND PERCEIVED WELL-BEING IN MOZAMBIQUE IN 2001-2002

By

T. Walker, D. Tschirley, J. Low, M. Pequenino Tanque, D. Boughton, E. Payongayong, and M. Weber

Research Report No 57 E
May 2004

Republic of Mozambique

DIRECTORATE OF ECONOMICS

Research Paper Series

The Directorate of Economics of the Ministry of Agriculture and Rural Development maintains two publication series for research on food security and agricultural policy issues. Publications under the Flash series are short (3 - 4 pages), carefully focused reports designated to provide timely research results on issues of great interest. Publications under the Research Paper series are designed to provide longer, more in depth treatment of food security issues. The preparation of Flash reports and Research Reports, and their discussion with those who design and influence programs and policies in Mozambique, is an important step in the Directorates's overall analyses and planning mission.

Comments and suggestion from interested users on reports under each of these series help to identify additional questions for consideration in later data analyses and report writing, and in the design of further research activities. Users of these reports are encouraged to submit comments and inform us of on-going information and analysis needs.

Carlos Mucavele
National Director
Directorate of Economics
Ministry of Agriculture and Rural Development

ACKNOWLEDGEMENTS

The Directorate of Economics is undertaking collaborative research on food security with Michigan State University's Department of Agricultural Economics. We wish to acknowledge the financial and substantive support of the Ministry of Agriculture and Rural Development of Mozambique and the United States Agency for International Development (USAID) in Maputo to complete food security research in Mozambique. Research support from the Bureau of Economic Growth, Agriculture and Trade/Agriculture program of USAID/Washington also made it possible for Michigan State University researchers to contribute to this research. This report does not reflect the official views or policy positions of the Government of the Republic of Mozambique nor of USAID.

Thomas Walker
Country Coordinator
Department of Agricultural Economics
Michigan State University

MADER/MSU RESEARCH TEAM MEMBERS

Carlos Mucavele, National Director, Directorate of Economics
Higino de Marrule, Coordinator of Policy Analysis Department
Aurélio Mate, Head, Statistics Department
Pedro Arlindo, Research Associate and SIMA Advisor
Anabela Mabote, Research Associate and SIMA Advisor
Antonio Manuel Paulo, SIMA Coordinator
Simão C. Nhane, Senior Assistant to SIMA Coordinator
Argentina Balate, SIMA Analyst
Inocêncio Banze, Trainee Research and Agriculture Policy Analyst, MADER
Francisco Morais, Enumerator Trainer
Abel Custódio Frechaut, Junior Assistant to SIMA Coordinator
Olivia Govene, Agriculture Policy Analyst, MADER
Liria Sambo, Agriculture Policy Analyst, MADER
Jaquelino A. Massingue, Agriculture Policy Analyst, MADER
Maria Pequenino Tanque, Trainee Research and Agriculture Policy Analyst, MADER
Maria de Lurdes Selemane, Trainee Reseach and Agriculture Policy Analyst, MADER
Zelia Machai, Trainee Research and Agriculture Policy Analyst, MADER
Benedito Cunguara, Trainee Research and Agriculture Policy Analyst, MADER
Natércia de Sousa, Trainee Research and Agriculture Policy Analyst, MADER
Arlindo Rodrigues Miguel, Agriculture Policy Analyst, MADER
Raúl Óscar R. Pitoro, MSU Graduate Student and Research Assistant
Danilo Carimo Abdulá, MSU Graduate Student and Research Assistant
Rui Benfica, MSU Research Associate and MSU Ph.D. Student
Maria Jose Teixeira, Administrative Coordinator
Amélia Soares, Administrative Assistant
Ellen Payongayong, MSU Analyst and Statistics Training Coordinator in Mozambique
Thomas Walker, MSU Analyst and Country Coordinator in Mozambique
Jan Low, MSU Analyst and Principal Investigator for Sustainable Nutrition Improvement Project in Mozambique
Duncan Boughton, MSU Analyst
Cynthia Donovan, MSU Analyst
David Mather, MSU Analyst
David L. Tschirley, MSU Analyst
Michael T. Weber, MSU Analyst

EXECUTIVE SUMMARY

The purpose of this research paper is to help design more effective strategies for accelerating rural economic growth in Mozambique by understanding the sources and determinants of rural household income. The analysis presented is directly relevant to the forthcoming revision of the national poverty reduction strategy (PARPA) and the second phase of the national agricultural development program (Proagri).

The analysis is based on a Ministry of Agriculture and Rural Development (MADER) survey of a nationally representative sample of rural households conducted in 2002 (called the *Trabalho de Inquerito Agrícola,* commonly known as "TIA"). The survey was undertaken by the Department of Statistics (DEST) in the MADER's Economics Directorate (DE) and covered the agricultural year 2001-2002. The TIA complements the *Inquerito do Agregado Familiar* (IAF) undertaken by the Ministry of Plan and Finance. While IAF measures the value of household consumption, the TIA provides data on the income that enables visible consumption. While the IAF provides a good measure of consumption poverty, the TIA provides additional information that can help identify strategies to increase income and reduce poverty in the future.

Rural incomes are calculated from TIA data as the value of own production and off-farm earnings less any paid out costs. Income sources include (1) net crop income, (2) livestock income, (3) off-farm self-employment, net small-business income, (4) off-farm self-employment, resource-extraction income, (5) off-farm agricultural wage income, (6) off-farm non-agricultural wage income, and (7) net remittance income. Since information was not collected on the value of consumption of home-produced fruits, vegetables and livestock products (to reduce the time burden on questionnaire respondents), rural household incomes are underestimated.

Mean household annual income is estimated at $280 per household and $65 per capita during 2001-2002. The corresponding median values (the mid-point of the sample when ranged from lowest to highest) are $140 per household and $30 per capita. Almost all households generated crop income, and over 70% of households had at least one non-crop source of income. The weighted average share of crop income was 67%, with one fifth of total crop value marketed and the remainder consumed on the farm. Cassava, maize and legumes are the most important sources of crop income. Livestock contributed 3% of total household income, with the largest contribution from goats, followed by cattle and chickens. Participation in self-employment activities rises across household income groups, with one third of total self-employment income coming from the exploitation of natural resources and two thirds from small businesses. Salaried employment has a big impact on income levels but is confined to a small proportion of households. The general picture that emerges ten years after the Lusaka peace accords that marked the end of the civil war is one of a fragile rural income base built on crop-based subsistence agriculture and complemented in the drier southern provinces by off-farm employment opportunities.

An understanding of the factors associated with different household income levels can provide insights into development strategies and policies that can accelerate income growth and reduce rural poverty in the future. This understanding is obtained through multiple regression analysis to explain observed variation in household incomes. The variables used to explain this variation fall into the following categories: demographic factors (household head gender, household size and composition, education), household asset base (land, cashew and coconut trees, livestock, equipment), access to information, technology and organizations, community attributes and infrastructure, exposure to risks and agro-ecology. The paper undertakes a similar analysis of

the impact of these variables on the incidence and severity of poverty (on a per capita basis) to allow simulation of the impact of alternative interventions on poverty reduction. An analysis of household perceptions of changes in their well being over the past three years provides consistent results with the analysis of income determinants and severity of poverty.

Women-headed households are significantly disadvantaged in income compared to households headed by men. This finding applies particularly to widow-headed households who had 30% less income than male-headed households, representing the combined effect of significantly lower income from crop production, livestock sales, resource extraction and non-agricultural wage earnings. Older household heads have lower income from off-farm sources, but higher levels of remittance income. The presence of very young children was associated with a small but statistically significant decline (4%) in household income. Older children, aged 5-14, were characterized by a small, but statistically significant, improvement in income prospects. Adding a man to the household was correlated with a significantly greater gain in income than adding a woman to the household. Simulation of adding a young child to the family has a big impact on the severity of poverty, whereas a 50% reduction in the population of widow-headed households does not (in part because they represent barely 10% of the household population and have small household size).

More schooling was identified with higher income. Nonetheless, at least three years of schooling were required to confer a statistically significant advantage in income. The small minority of households with heads who have five or more years of schooling were clearly separated from the large majority of less educated households. The positive effects on income sources are most pronounced in small-business self-employment and in non-agricultural wage employment. More educated household heads are significantly less likely to engage in and earn remuneration from extractive self-employment activities and from agricultural wage employment. Surprisingly, neither crop or livestock income sources are significantly associated with the level of schooling, suggesting a technologically stagnant agriculture where increased capacity to process information from schooling is not a demonstrable advantage. Nevertheless, simulation of an improvement in the educational level of household heads has a major impact on poverty reduction.

Household asset base plays an important role in household income. Both land area owned and number of fields are positively associated with income. The largest farm size group has an 87% higher net crop income (and 45% more total household income) on average compared to the lowest size group, while an increase in the number of fields from one to two is accompanied by a 25% increase in net crop income. Irrigation is also strongly correlated, contributing a 22% increase in net crop income on average. Communities where farmers said that it was easy to obtain more land had significantly higher net crop and livestock income and significantly lower receipts from agricultural wage employment. Simulations of an increase in farm size or crop diversification have positive impacts on poverty reduction similar in magnitude to improving the education of household heads. Specifically, graduating the medium-farm size group of (1.75-5.0 ha) to the largest group of more than 5 hectares generated about 3-4 times more poverty-reduction impact than shifting the smallest land-owning group (less than 0.75 ha) to the next level (0.75-1.75 ha). This indicates the strategic importance of fostering the emergence of a commercial smallholder group of farmers.

For those households in the top 5% of tree ownership, coconut and cashew have a significant effect on household income. But in the case of cashew, even for households among the top 5% in terms of number of trees owned the contribution is relatively low (18% higher net crop

income). The underlying causes of this disappointing performance are well known but have not yet been resolved.

Households with ten or more cattle, or twenty or more goats, achieved significantly higher household income than those with fewer or none. But even small numbers of chickens owned were associated with an income advantage, confirming the potential contribution of poultry to poverty reduction. Simulations of the impact on poverty reduction of intensifying chicken production are much greater than intensifying cattle production because of the larger proportion of households involved.

Bicycle ownership is strongly correlated with net crop income and small business income. This is consistent with the commonly observed practice of farmers using cash crop sale earnings to purchase bicycles that are subsequently used for small business activities.

Access to information and organizations gave mixed results. Higher income farmers are more likely to be members of associations, while households who received price information realized an 11% income advantage over those who did not receive such information. Agricultural extension had no measurable impact on either net crop income or livestock sales. Multiple explanations could be offered for why extension information may not be affecting rural income. Constraints on access to improved inputs and to more location-specific adapted technologies could figure prominently among these reasons.

Geographical location and infrastructure potentially affects on and off-farm household income earning opportunities. Other than the positive correlation between infrastructure and off-farm salaried income opportunities, the data on infrastructure variables provide few insights. With regard to geographical location, the high altitude north-central region (agro-ecology 10 using INIA's classification) was characterized by 142% greater net crop income than the reference agro-ecology, the wet central coast (agro-ecology 5). Higher elevation is associated with greater crop choice and easier varietal adaptation for some important species, such as maize, combined with greater population density and proximity to markets in wealthier neighboring countries. The Zambezia Valley and south Tete (agro-ecology 6) scored well on livestock sales and small-business income. As expected, off-farm non-agricultural wage earnings and remittances were higher in the two southern agro-ecologies (2 and 3) nearer South Africa. This is in part a reflection of the compensatory role that resource extraction activities often play in higher risk agro-ecologies. Community settlement also plays a role. Villages that were settled after independence had higher household incomes than older villages, as did villages with clustered as opposed to dispersed settlement patterns.

A number of key policy implications flow from the analyses undertaken. While there is clear evidence of a rural economy dynamic in tobacco-growing areas and the north-central agro-ecology, the agricultural sector as a whole is under-performing relative to its potential contribution to poverty reduction. There is an over-arching need to improve the profitability of Mozambican agriculture through investments in technology that raise productivity, and reductions in the cost of input and output market access. Specific measures to be taken include:

1) Promote the emergence of commercial smallholder group of farmers through access to improved technologies and related services (input and output markets, extension and market information, financial services, land titling);

2) Expand smallholder access to low-cost methods of irrigation and/or conservation farming techniques to reduce risk (in contrast to the recent emphasis of heavy investment in formal perimeter irrigation schemes);

3) Promote a diversified range of crop production and market opportunities available to smallholders;

4) Enable a higher proportion of rural households to maintain a viable poultry enterprise;

5) Develop and implement a more integrative approach to gender programs that ensures widows are not bypassed by agricultural development programs, and that educates men and women on family spacing and HIV/AIDS prevention;

6) Urgently review current policies and strategies for cashew and cotton that potentially affect the welfare of a large number of rural households; and

7) Further improve the effectiveness of the TIA survey as an instrument to monitor the contribution of the agricultural sector to poverty reduction by adopting a panel sample (repeat visits to the same households over time) and collecting additional information on agricultural technology and market access.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Since the signing of peace accords in 1992, Mozambique's aggregate economic performance has significantly eclipsed most countries in Africa. Yet Mozambique is still regarded as one of the poorest countries in the world with per capita GNP barely exceeding $200 (World Bank 2003). Most Mozambicans live in the countryside and cultivate small fields with hand hoes. Therefore, rural income looms large as an important index of welfare and living standards.

The importance of information on agricultural production and rural income has not gone unnoticed in Mozambique. Prior to the cessation of hostilities, farmers in Nampula, a province of high production potential, were flown to safe locations and interviewed about their crops, food consumption, and marketing activities (Tschirley and Weber 1994). In 1994, a national agricultural production survey known as the Trabalho de Inquerito Agricola (TIA) was undertaken. The first national rural income survey was carried out in 1996. In 2000, more than 20,000 of the population of about 3,000,000 rural households were interviewed in a "sample" census. In 2002, the second national income survey, commonly known as the TIA 2002, was canvassed. The second national income survey was more comprehensive in coverage than the first, and it received extensive financial support from donors and the Ministry of Agriculture and Rural Development.

In spite of these impressive data collection activities, the picture about rural income in Mozambique is far from complete. Most of the results of the surveys are found in unpublished reports that contain basic tables. No attempt has been made to synthesize results from the four survey sources that have received variable analytical attention. Perhaps the most intensive analytical effort was made by Benfica (1997) who delved deeply into micro-enterprise activities in the 1996-97 rural income survey. A systematic comparison of the first and second income surveys is now a priority and the subject of a forthcoming paper. That work focuses on the question: Has Mozambique's excellent recent aggregate economic performance translated into appreciable growth in rural income?

In this paper we address a neglected complementary theme: the determinants of rural income. Understanding the determinants of rural income can be a powerful guide to designing effective interventions to accelerate rural income growth and reduce the incidence of poverty in the future. The analysis is therefore directly relevant to the implementation of the government's national poverty reduction strategy (PARPA) (Ministry of Plan and Finance, 2001), and especially the second phase of the national agricultural development program (PROAGRI 2) due to start in early 2005. From a perspective of "determinants," we also examine income sources, income poverty, and perceived change in economic condition. The raw material for our analysis is the TIA 2002, designed for rural income and intensively supervised on a nationally representative sample.

Our analysis complements earlier research that assessed the determinants of rural and urban welfare from the lens of consumption expenditure (Datt et al. 2000; MPF 2004). Nowadays, investing in surveys of consumption expenditure is a standard practice in poverty analysis, and consumption poverty is the dominant perspective for measuring the level of and changes in economic well-being. When objectives focus on measuring poverty and monitoring progress

over time, the advantages to a perspective based on consumption expenditure are clear: rural income fluctuates in response to the agricultural year, and estimated income is more likely to be underreported than estimated consumption expenditure.[1]

On the other hand, the analysis of data on consumption expenditure may not be that informative for agricultural development policy. When research objectives shift to 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 because data on the relevant agricultural variables are not collected or are incomplete or because variation in data on consumption expenditure is relatively small and more difficult to explain.

Again, the report by Datt et al. 2000 is a case in point. The determinants of regional rural consumption expenditure were dominated by demographic and educational variables. Only two out of nine agricultural-related independent variables, the stock of trees (other than cashew, citrus, and coconut) and substantial livestock holdings, were statistically significant in at least two of the three regions analyzed. None of the nine simulations that related to agriculture led to more than a 10% decline in the severity of poverty. In contrast, four of the five simulations that centered educational change resulted in reductions in the severity of rural poverty that ranged from 14 to 39%. The agriculturally related scenario that resulted in the largest reduction (8%) in rural poverty was blanketing all cultivated area with modern inputs. Unfortunately, modern inputs, such as inorganic fertilizer, presently only occupy 3-5% of cultivated area. On the basis of such results, one could easily draw the erroneous conclusion that investing in agriculture was not going to make much of a dent in rural poverty.

The purpose of this paper is to help guide the design of rural development interventions to accelerate income growth and poverty reduction. The paper first describes the TIA 2002. This description carries over to the next section on the specification of the variables in the determinants of income evaluation that is the first of our four interrelated analytical themes. Next we look at the determinants of the sources of income. The determinants of the incidence and severity of income poverty are addressed in the third analytical section that also contains simulated results of alternative development scenarios on poverty. Our analysis closes with an examination of the determinants of perceived change in economic condition. We sum up the results and discuss their implications in a concluding section.

[1] For example, our mean estimate of income per person per day (in constant prices) from the TIA 2002 is only about 50% of the estimate of consumption expenditure per person per day reported by Datt et al. (2000) for the national household survey on living standards conducted in 1996-97 by the Mozambican national statistical agency. A large share of this 50% gap is attributed to the evaluation of consumption expenditure in higher retail prices and income in lower producer prices. Nevertheless, part of this difference has to come from the underreporting of income notwithstanding the length of the questionnaire nor the care with which the interview was conducted. Mainly for this reason, studies addressing income poverty in developing countries are rarely published in the formal literature.

2. DESCRIBING THE TIA 2002 AND LEVELS AND SOURCES OF HOUSEHOLD INCOME

2.1. The Sample Survey

The TIA 2002 was implemented by the Department of Statistics (DEST) within the Directorate of Economics of the Ministry of Agriculture and Rural Development (MADER) during July to October 2002 for the agricultural year 2001-2002 covering September 2001 to August 2002 (MADER 2002). The sampling frame was based on that developed for the "sample" Census of Agriculture and Livestock 2000 (CAP). The sample was stratified by province and agro-ecological zone. Eighty of the country's 128 districts were included in the sample. A total of 4,908 small and medium-sized farms were interviewed in 559 communities that were the primary sampling units. These data on small and medium-sized households were complemented by group interviews at the community level and by area measurements of about 2,500 of the 12,000 fields operated by respondent households.[2]

The TIA 2002 is the most ambitious attempt to elicit comprehensive information on rural household income in a single-interview survey for all of Mozambique's 10 provinces. Questions were asked on more than 100 potential sources of farm and non-farm income. The TIA 2002 was heavily supervised: three to four enumerators per supervisor. It also featured several technological innovations, such as the use of field data entry and editing using laptop computers in two provinces, and field measurement based on satellite information using GPS instrumentation for fields larger than 0.3 hectares. For these reasons, we believe that widespread underreporting of income – the main weakness of single-interview rural income surveys – was limited mostly to consumption of farm-produced fruits, vegetables, and livestock. For these commodities, the focus in the TIA 2002 was on sales.

Because of the importance of agriculture, results from income surveys are obviously affected by the weather, both in Mozambique and the neighboring countries that are key trading partners. Ideally, we want to conduct the survey during a "normal" agricultural year. The crop year 2001-2002 was characterized by drought in some provinces and districts, and farmers were still recovering from the severe floods experienced in 2000. On a positive note, Mozambican farmers benefited from unusually strong border trade in maize as several neighboring countries experienced shortfalls in 2001-2002. Overall, we feel that the 2001-2002 agricultural year was not atypical.

We made two major corrections to the survey data. Cassava production was underreported because of a flaw in questionnaire design that was not corrected during the conduct of the survey in Nampula, one of the largest cassava-growing provinces. Cassava is harvested in several months of the year with smaller piecemeal harvests complementing larger seasonal harvests. We imputed production in a regression format for those farmers who said they grew the crop but did not report output from farmers who cultivated cassava and reported production. We also adjusted reported field areas downwards because measured areas were significantly smaller (at 85%) than declared areas. This area adjustment only affected income estimates when imputations were made such as for the case of cassava described above.

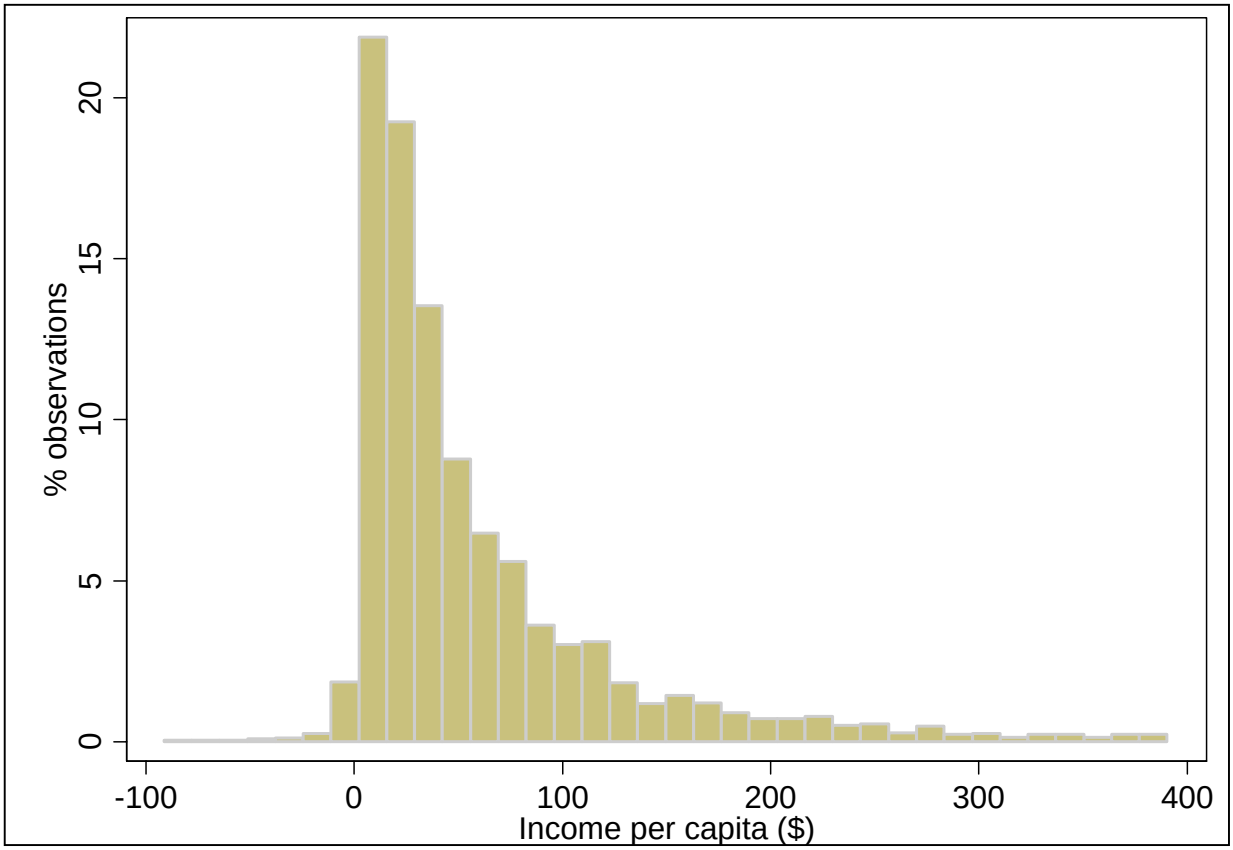
[2] A separate census of all large farm households was also conducted. Large farms were defined on land or livestock criteria, and they numbered about 400. Most of these farms were medium-sized cattle ranches. These large farms represent a tiny fraction of agricultural holdings in Mozambique. The data from the census of large farm households are not analyzed in this paper.

2.2. Levels of Household Income

Income is defined as returns to household owned resources. This concept is equivalent to value of production minus paid-out costs. Consumption from own farm production was valued at median producer prices by commodity by district.

Rural income levels were very low in Mozambique in 2001-2002. Mean income was estimated at about $280 per household and $65 per capita. Given the long tail to the right of the rural income distribution estimated in Figure 1, the median or mid-point estimate is a more reliable estimate of central tendency than the mean which is considerably higher than the median. Median per capita income was only about $30 (USD) per head; median household income approached $140. The six poorest of the ten provinces had median levels of per capita income that ranged between $28-32. Most households were tightly clustered in the low levels of the frequency distribution of income (Figure 1). The frequency group with the most observations in Figure 1 is the next to the lowest one with 15-20% of the households having between $10-20 per capita.[3]

Figure 1. Frequency Distribution of Per Capita Income in $US



[3]Part of the problem of low incomes described in Figure 1 could stem from negative income households that pull down mean estimates. However, only 70 households generated losses to their own resources in 2001-2002, and a very small minority of four households did not report any income. Therefore, these low levels of income cannot be attributed mainly to a bad agricultural year.

Table 1. Mean Annual Household Income by Province (2001 US$) [a]

Province	Mean	95% Confidence Interval	
		(US $)	
Nampula	213	180	246
Cabo Delgado	215	191	239
Zambezia	231	138	325
Manica	252	235	268
Sofala	309	234	383
Niassa	337	259	414
Gaza	382	276	488
Tete	392	275	510
Inhambane	580	417	742
Maputo	593	447	738

[a] Weighted population means, excluding negative income households.
Source: TIA 2002

Although comparisons with similar estimates from income surveys from other countries in East and southern Africa are beset by problems in adjusting for price levels, the Mozambican estimates seem low from a regional perspective. Earlier estimates from the 1996-97 survey in Mozambique were also lower than comparable estimates from other rural household surveys in Ethiopia, Kenya, Rwanda, and Zambia (Jayne et al. 2003). These low levels bear witness to the depth of the economic abyss rural smallholders found themselves in following several centuries of colonial neglect and 16 years of civil war.

Perhaps the most surprising aspect of this finding of very low rural income is the lack of separation of households in the tightly clustered distribution of income in Figure 1. With one of the highest rates of aggregate economic growth of 4.0% percent in GNP per capita in Africa from 1990-2001 (World Bank 2003), we would have expected more households to have distanced themselves from the very low-income majority.

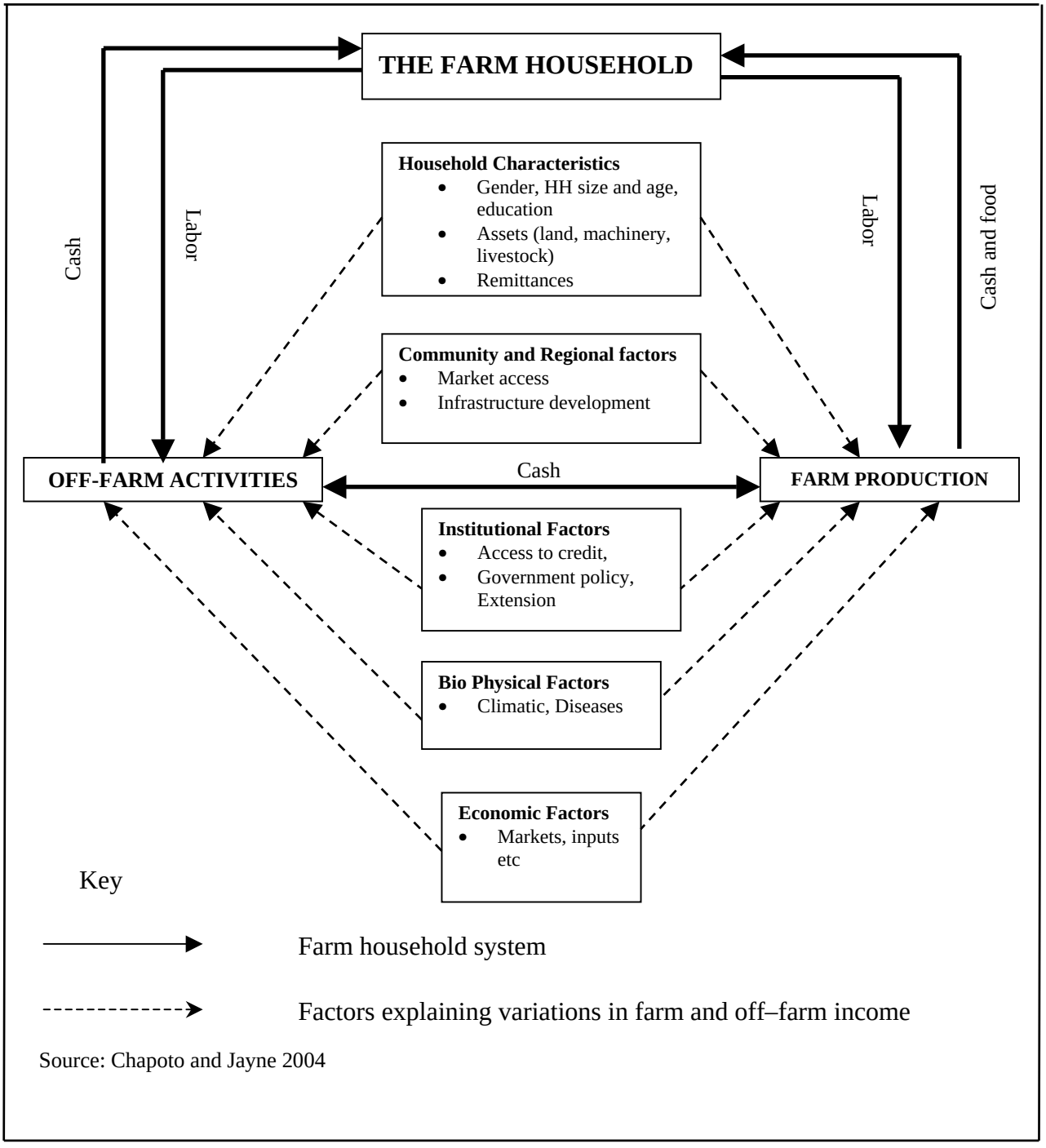
The mean weighted estimates of household income are given for Mozambique's ten provinces in Table 1. In general, rural income was higher in the southern than in the central and northern provinces. Somewhat surprisingly, rural household income was lowest in Nampula and Zambezia, two of the more densely populated provinces with higher production potential. The low-income estimates for Cabo Delgado could partially be attributed to a localized drought in 2001-2002. The mean rural household income of Gaza, Tete, Inhambane, and Maputo was significantly higher at the .05 level than the three lowest provinces in Table 1. Of the interior provinces, both Tete and Niassa were notable for higher rural income in 2001-2002.

2.3. Sources of Household Income

The first step in the analysis of rural household income levels is to identify the importance of different sources. Figure 2 provides a schematic breakdown of the division of labor between farm production and off-farm activities. Several conditioning variables grouped in the five interior boxes in Figure 2 affect outcomes from investing in farm production and off-farm activities. Some of these variables are external to the household and others are internal. These

factors and characteristics are discussed for the rural Mozambican context in the next section. The household allocates labor and cash between farm and off-farm income earning activities. We divide income from farm production into crop and livestock income. The main sources of off-farm income are self-employment income, off-farm salary and wage income, and remittances.[4] In section 4, we use a finer breakdown of off-farm income to distinguish behavioral differences within these major sources.

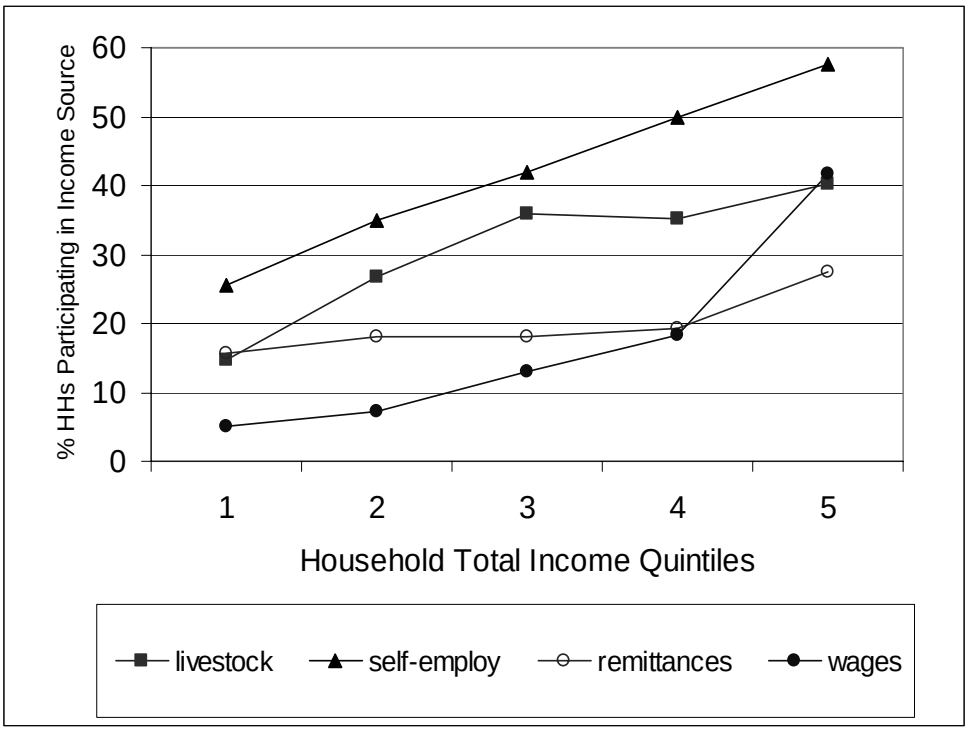
Figure 2. Sources of Rural Household Income



Source: Chapoto and Jayne 2004

[4] Mozambique is a land abundant country and income from land market transactions, such as rents, is only found near cities and is a negligible source of income.

Figure 3. Percent of Households Receiving Non-Crop Income by Source by Income Quintile

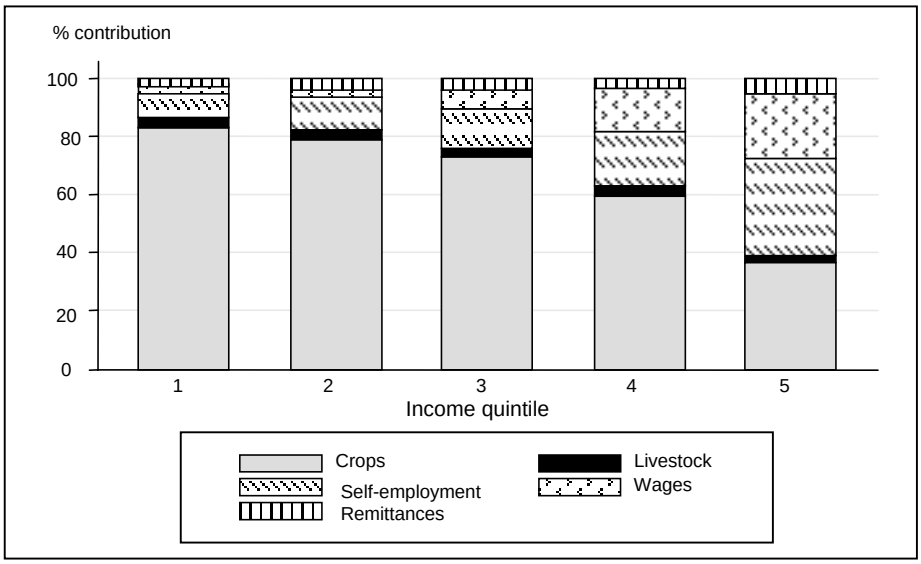


Over 90% of households in all income groups generated crop income. The frequency of participation in non-crop income sources increases with income however (Figure 3). Consistent with the literature on rural non-farm employment in Sub-Saharan Africa (Reardon 1997), the highest income households – quintile 5 in Figure 3 – had diverse sources of income. Off-farm income was also important for a sizable minority of households. Self-employment is the non-crop income source most widely engaged in, rising from 25% of households in the lowest income quintile (i.e. the 20% of households with lowest incomes) to almost 60% of households for the highest quintile. Livestock income is the second most widely experienced income source, again rising with income from approximately 15% for the lowest household income quintile to 40% in the highest. Wage income is the least equitably experienced income source, rising exponentially from a low of barely 5% for the lowest income quintile to over 40% for the highest. Between 15% and 20% of households in all income groups receive remittances, with the exception of the highest income quintile where almost 30% of households receive remittances.

Turning from participation in different income-generating activities to their relative importance in gross household income, the weighted average share of crop income was about 67% (Figure 4). Of this share, about four-fifths was attributed to the value of home production consumed on-farm and only one-fifth came from marketed sales.

Livestock only contributed about 2-3% of total household income in Figure 4. Moreover, the share did not vary by income level. Both of these findings are contrary to the conventional wisdom for Africa where livestock, with the exception of the humid forest agroecology, plays an important role in income and is positively associated with richer households. Among species, the contribution from goats was largest, followed by cattle and chickens. The low importance of cattle is conditioned by several factors, mainly depleted herds from 15 years of civil war and the prevalence of the tsetse fly in several regions of the country.

Figure 4. Shares of Gross Income by Source by Income Quintile



Self-employment income from micro-enterprises was the most important of the three sources of off-farm income graphed in Figure 4. About one-third of this income came from the exploitation of natural resources, such as the felling of trees and selling of charcoal, on or near the farm. The other two-thirds was derived from revenue generated from small businesses. The making of beverages was the most commonly cited self-employment activity. This finding of the greater importance of self-employment income relative to earnings from wage labor is not common in the literature (Reardon 1997) and suggests that growth in agricultural employment has not kept pace with aggregate growth computed from national accounts data.

Self-employment activities made a positive contribution across all levels of household income. Even the 20% poorest households derived nearly 10% of their income from this source. Earnings from wage and salary employment were not as equitably divided as income from self-employment. Although temporary agricultural labor was the most frequent form of wage employment reported, its duration was too brief to elevate households into the higher income quintiles 4 and 5. About 10-15% of the households had access to more permanent off-farm jobs, often requiring some skill and specialization. These diverse employment opportunities lasted several months or longer and were sufficient to propel these households into the higher income quintiles. This source is mainly responsible for stretching the income distribution. Remittance income made a more modest contribution (3-5% in Figure 4). Its importance did not vary greatly by income class.

The data in Figure 4 warrant three more comments. First, value of production from crops remains the dominant source of rural household income. The importance of crop income is even higher from the perspective of the median instead of the mean share (percent contribution). The median percentage contribution for crop income was 75%. Hence, 50% of the households rely overwhelmingly on crops as an income source. Root and tuber crops, mostly cassava, made the largest contribution to household income closely followed by cereals, predominantly maize. The bulk of root and tuber crops are consumed on-farm. Together roots and tubers and cereals accounted for about three-fourths of the contribution made by crops to household income.

About half of the remaining 25% came from beans and groundnuts. Annual cash crops, cashews and coconuts, horticultural crops and fruit species comprised the remaining one-eighth. Second, the mean shares of farm and off-farm income vary markedly by province. At one extreme, rural households in Maputo (in the south) attribute on average about 50% of their total income to the three off-farm sources in Figure 4. On the other hand, the share of off-farm income in the northern province of Niassa does not reach 20%. Off-farm income looms large in the drought-prone southern provinces of Inhambane, Gaza, and Maputo. Lastly, urban growth in the southern provinces and in South Africa most likely explains part of the importance of off-farm income in the South. This finding on the prevalence of off-farm income may be unique to the South and will be hard to replicate in the northern and central provinces without agricultural growth.

We close this section with one of the most interesting and alarming statistics in the TIA 2002 data. Almost all households produce several food crops, but the amounts harvested are truly small. Half of the households that cultivated maize produced less than 250 kgs (Table 2). Even the top 1% of cultivators did not break the 1-ton level in 7 of the 13 commodities listed in Table 2. The mean weighted average sum across all these crops was only 1.7 tons of total farm production. The small quantities of production in Table 2 suggest an undifferentiated smallholder sector, a reoccurring theme of this report.

Table 2. Distribution of Production (in kg) of the Most Important Annual Food Crops by Percentile

		Percentile production (in kg.)			
Crop	Observations (no.)	50%	90%	95%	99%
Maize	4265	250	1349	2198	6503
Cassava	3421	792	3083	3899	7168
Cowpea	2906	9	59	101	290
Groundnut (small-seed)	2015	15	109	184	406
Sweet potato	1984	108	948	1666	4686
Sorghum	1793	52	298	498	1190
Common bean	1439	10	56	74	201
Rice	1321	49	218	349	1455
Pigeon pea	1166	10	99	171	411
Groundnut (large-seed)	1058	21	128	213	524
Butter beans	757	28	276	461	856
Millet	540	24	151	259	606
Potato	143	85	681	937	4131
All 13 crops	4908	1149	3936	5354	11048

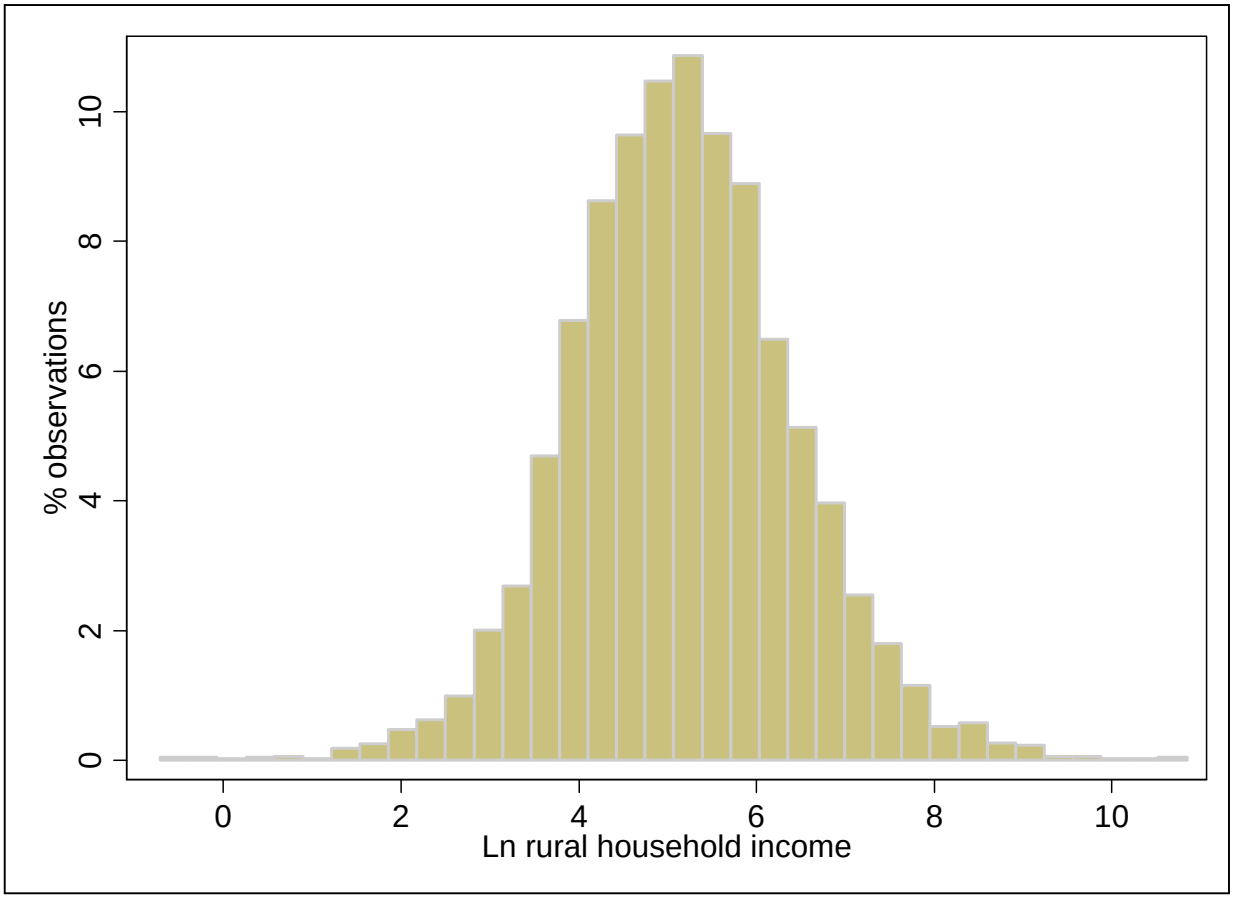
3. DETERMINANTS OF HOUSEHOLD INCOME: DESCRIBING THE VARIABLES

The independent variables that potentially explain the variation in rural income are described in this section. The dependent variables are household and per capita income. As we saw earlier in Figure 1, income is positively skewed, departing significantly from a normal distribution. We follow the conventional practice of taking the natural logarithm of household and per capita income to transform the data. The transformed data for household income in closely resemble a normal distribution (Figure 5).

Using a logarithmic transformation on the dependent variables comes at a cost of excluding the negative and zero income observations from analysis. Seventy-one households incurred net losses in income, and four households did not report any income. Therefore, the number of observations for analysis falls from 4,908 to 4,833. These 75 households most likely experienced transitory poverty in 2001-2002. Our analysis focuses on the variation in more "permanent" levels of income; hence, exclusion of these observations is not a major cause for concern.

The independent variables for these 4,833 observations are described in Tables 3a through 3f. The independent variables are grouped into larger categories for discussion and come from

Figure 5. The Distribution of Household Income with a Natural Log Transformation



either the household or the community questionnaire. Most of the independent variables are categorical (0-1) and are expressed as dummy variables (0-1). We also model two continuous variables, age of head of household and farm size, as categorical variables to assess threshold effects. The dummy variable specification facilitates the construction and interpretation of the simulated scenarios on poverty. Therefore, the estimates in Tables 3a through 3f refer to proportions in each category with the exception of the family composition and production risk variables that are continuous. The weighted mean incorporates information on sample design and refers to a population of 3,061,679 rural households. The unweighted mean is the number of households in the dummy variable or category of interest divided by the 4,833 observations suitable for regression analysis on the determinants of income.

Medium-sized operations were sampled at a higher rate than smallholder households; therefore, large discrepancies between the two means in Tables 3a through 3f occur in the estimated proportions of households with 10 or more head of cattle (.081 versus .008) and, to a lesser extent, large herds of goats, animal traction, more than 5 hectares, tractors, and mechanized pump-sets. We usually refer to the weighted means in Tables 3a through 3f and incorporate the sample design into the technique used (OLS, Logit, or Tobit) in the regression analysis to derive weighted estimates.

Any determinants analysis must make judgments about the degree of endogeneity or exogeneity of potential explanatory variables. As noted by Appleton (2001), any such judgments are bound to be controversial, and care must be exercised when drawing conclusions. We excluded from our main income regression several potential variables due to concerns about endogeneity. These include growing of horticultural crops, use of purchased inputs, hiring of labor on farm, and working off the farm. All these variables contribute to income but also may reflect decisions based on previous income results. In other cases, we formulated the variable to avoid endogeneity problems. For example, our land variables are based on owned land, not cultivated land, we include number of fruit trees but not decisions to produce fruit or vegetables, and crop diversification is measured at the community level, not the household level. We have chosen to include some variables for which we expect the direction of causation to move both ways, because excluding these variables would create other econometric problems. These variables include asset ownership, access to information, and membership in associations. We interpret the estimated coefficients on these variables very carefully.

3.1. Gender

A woman is the head of about one in every four households (Table 3a). About 45% of these women are widows. We expect that women-headed households will have less income than male-headed households. Moreover, widows are likely to be the most disadvantaged group among female-headed households.

3.2. Age, Family Size, and Composition

Typical of most other rural surveys in developing countries, average age of the household head was in the early forties (42) in Table 3a. Also consistent with most other studies, we expect that income will reflect a quadratic life-cycle pattern with age. Income increases, reaches a peak, and then declines with age of the household head. Instead of using a continuous specification for age of household head, we believe that the data have a better chance of telling a persuasive story if they are grouped as dummy variables by “logical” threshold limits such as decades in Table 3a.

Table 3a. Description of the Household Characteristic Variables

Variable category		Description	Sample mean		
			Unweighted	Weighted	Expected sign
General	**Specific**				
Dependent		ln household income	5.165	4.992	
		ln household income per capita	3.614	3.528	
Independent					
Household characteristics	Gender	Male-headed households[1]	.749	.744	
		Female-headed household: non-widows	.141	.152	-
		Female-headed household: widows	.110	.104	-
	Age	Younger than 30[1]	.198	.233	
		30-39	.229	.247	-
		40-49	.227	.225	+
		50-59	.171	.149	+
		60 and older	.175	.146	-
	Education (Head)	Illiterate: No schooling[1]	.448	.423	
		1-2 years schooling	.161	.170	+
		3-4 years schooling	.241	.255	+
		5 years or more schooling	.150	.152	+
	Composition	Number of children aged 0-4	.900	.832	-
		Number of children aged 5-14	1.640	1.478	+
		Males aged 15-64	1.196	1.104	+
		Females aged 15-64	1.518	1.320	+
		Persons 65 or older	.182	.144	+

[1] Reference category for dummy variables.

On average, family size is smaller in rural Mozambique than in most rural areas of southern and eastern Africa. Weighted average family size was 4.88. The most numerous demographic group was children aged 5-14 years, followed by females aged 15-64. The average number of males (1.10) in the 15-64 age group was significantly less than the average number of females (1.32) in the same age cohort. An elderly person (older than 64) resided in only about one household in seven.

The signs of the coefficients on family size in these demographic groups depend on the choice of the dependent variable. With the exception of the group aged 0-4 years, we expect positive signs on all the age groups when household income is the dependent variable. In contrast, when per capital income is used, our expectation is for negative signs on all the age groups. That is, the increase of one person cannot compensate sufficiently in generating income in the numerator (of per capita income) for the fall in income occasioned by a one-unit increase in the denominator.

We also expect that the size of the coefficients will be significantly different among groups. When household income is used as a dependent variable, we anticipate that the coefficient for males aged 15-64 will be significantly higher than for females aged 15-64 if men cultivate more

commercial crops or if men have more access to off-farm employment. If appreciable time was allocated for the care of young children, then the estimated coefficient of the group aged 0-4 could be negatively signed. A similarly small but, in this case, positive coefficient could be expected for the older children from the 5-14 age group who help around the farm, particularly in the herding of livestock.

3.3. Education

Many heads of household were uneducated; a large minority (42%) was illiterate. Only 15% had five or more years of schooling. We anticipate that educational level will figure prominently in determining income. The estimated coefficients should rise with each stepwise increase in the level of schooling in Table 3a. Only education of the household head is included as an independent variable in Table 3a because educational attainment of progeny is significantly linked to years of schooling of the head.

3.4. Land

The TIA 2002 is a rich source of information on land-related variables that could explain the variation in household income (Table 3b). These include: (1) farm size, (2) use of irrigation, (3) number of fields, (4) location-specific elevation, (5) how the field was obtained, and (6) perceptions of land scarcity at both the household and community levels.

The distribution of farm size in Figure 6 is similar to the distribution of income in Figure 1: significantly skewed to the right, but land is not as inequitably distributed as income. The mean farm size was about 1.66 hectares; the modal farm size ranged from 0.75 to 1.50 hectares. Mean area cultivated was only 1.33 hectares. The difference between mean area farmed and cultivated stemmed from permanent crop area (0.17) and fallowed area (0.13) and to a lesser extent pasture (.03).

After more than 10 years of peace, it is surprising that more farmers do not cultivate more land. Only 2% of households farmed more than 10 hectares, and these planted on average only about 10 hectares. The largest cultivated area in the sample was only 44 hectares. Before independence in 1974, the structure of Mozambican agriculture was bi-modal with large Portuguese-owned farms coexisting with a neglected subsistence agricultural sector. After independence, large companies were consigned extensive land areas by the government, but, with a few exceptions, the mode of operation remains smallholder contract farming. Large-scale corporate farming, for all intents and purposes, only exists in the sugar sector. Thus, more so than most other countries in southern and eastern Africa, a unimodal structure of agricultural production now prevails in Mozambique. But even for a unimodal structure of production, such relatively small areas sown by the largest farms in a sample of this size was unanticipated. Overall, the farm-size distribution in Figure 6 suggests smallholder agriculture is heavily reliant on hand-hoe agriculture with limited market incentives or technological potential for more extensive cultivation.

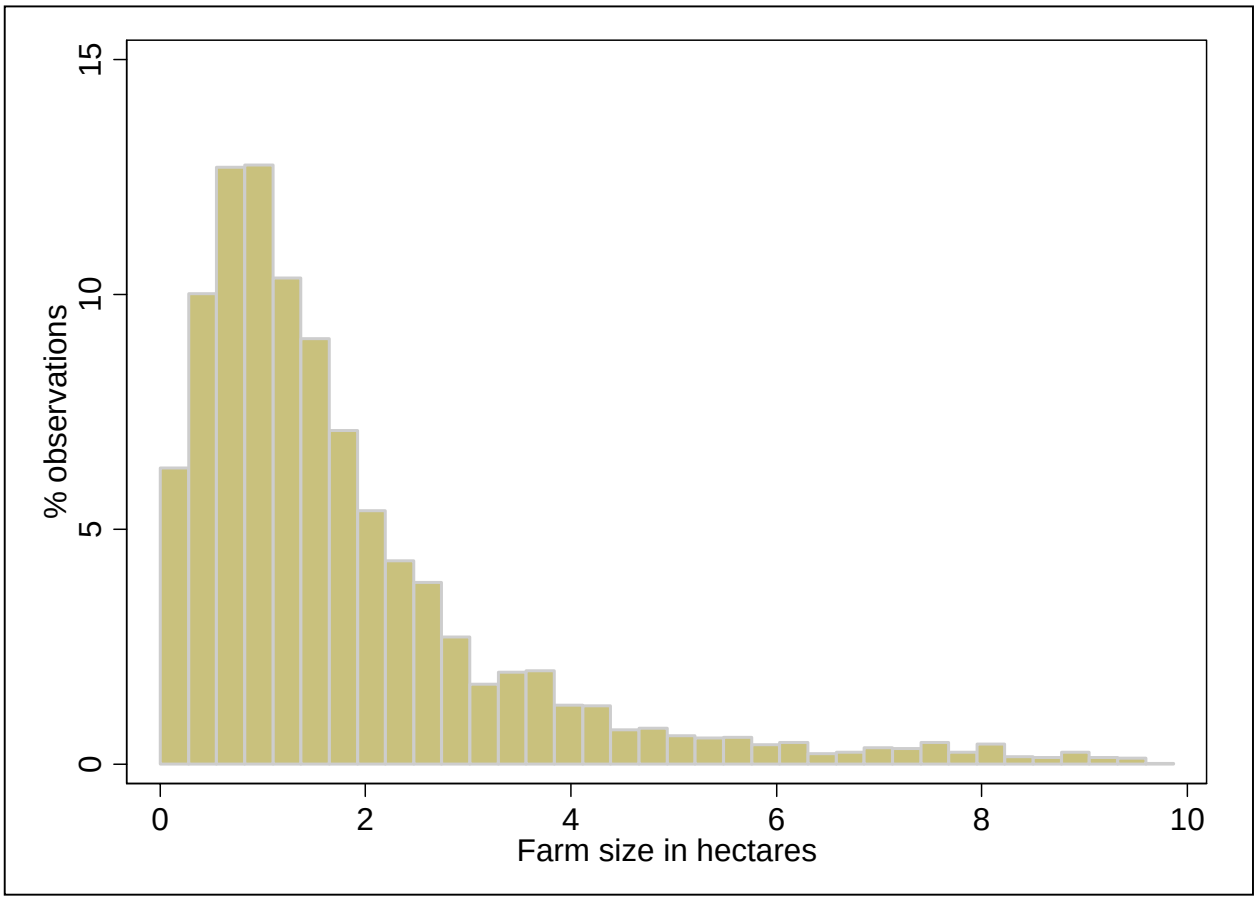
Table 3b. Description of the Land Variables

Variable category		Description	Sample mean		Expected sign
			Unweighted	Weighted	
General	**Specific**				
Dependent		ln household income	5.165	4.992	
		ln household income per capita	3.614	3.528	
Independent					
Land	Farm Size	Less than 0.75 ha[1]	.215	.265	
		0.75-1.745 ha	.372	.411	+
		1.75-5.00 ha	.328	.290	+
		More than 5.00 ha	.084	.034	+
	Irrigation	One or more fields irrigated	0.150	.159	+
	Field location	Lowland[1]	.172	.177	
		Upland	.429	.417	-
		Upland and lowland	.399	.396	+
	Availability	Easy to obtain: household level	.858	.852	+
		Easy to obtain: community level	.747	.720	+
	Number of fields	0 fields	.010	.012	?
		1 field[1]	.242	.224	
		2 fields	.332	.341	+
		3-4 fields	.334	.348	+
		5 or more fields	.083	.075	+
	Sources of land				
	1	Ceded by traditional authorities[1]	.097	.078	
	2	Ceded by government	.051	.032	+
	3	Ceded by parents	.167	.183	
	4	Borrowed or rented	.046	.058	+
	5	Occupied	.369	.370	
	6	Purchased	.035	.038	+
	7	Inherited	.217	.223	
	8	Others	.018	.018	

[1] Reference category for dummy variables.

Returning to the anticipated signs of the land-related variables in Table 3b, we expect that income will be positive and increasing in farm size for the three larger groups relative to the smallest (reference) group. Critical values of farm size for defining the groups were based on the distribution of fields. About one-fifth of the households farmed one field and this percentage was equivalent to a farm size of about 0.75 hectares. At the other end of the field and size distribution, about 8% of households farmed 5 or more fields and about one household in twelve operated more than 5 hectares. But the weighted means suggest that it was considerably more common for a household to have 5 or more fields than to have 5 or more hectares.

Figure 6. Distribution of Farm Size in Hectares



Although most irrigation in Mozambique is done manually, we expect that farmers who irrigated one or more fields will have higher income than households who relied exclusively on rain-fed agriculture. We also expect that farms with both upland and lowland fields will have higher income than farms limited to one elevation.

Our anticipated results on farm size, irrigation, and field location are typical of other studies on land and rural income generation. Now we describe two less conventional expectations. Farmers in Mozambique have relatively few fields. The majority of farm households cultivate two or fewer fields (Table 3b). Acquiring access to and cultivating another field requires considerable effort and commitment when hand-hoe agriculture is the dominant mode of cultivation. Holding farm size constant, number of fields could be a proxy variable for commitment to farming or could reflect a better matching of crops to topographic and soil-related needs. In either case, we expect a progression in the size of the estimated coefficients from the reference point of one field to the highest category with five or more fields.

The TIA 2002 also includes information on perceptions of land scarcity at household and community levels. About 85% of the household heads said that they could acquire more land for cultivation in the village if they wanted to. The majority of community leaders also felt that land was abundant in the village. A hypothesis of land scarcity or lack of access to land is consistent with positive estimated coefficients for these two variables. However, the responses

seem to reflect pockets of land scarcity in a general setting of land abundance; therefore, large positive effects on either of these variables would be surprising.

Operated area was almost synonymous with owned area. (Technically, all land in Mozambique is owned by the State; ownership refers to the use right.) Only 70 of the more than 12,000 fields reported in the survey were rented in. Borrowing fields from others was the principal means to expand operated area in the short run. The number of borrowed fields approached 600, equivalent to about 5% of all fields. Therefore, the bulk (95%) of the fields were owner-operated. In order of importance, farmers acquired their land via: (1) occupation, (2) inheritance, (3) their parents (other than inheritance), and (4) local chiefs. These four means accounted for 85% of the fields. The remaining fields were obtained through government programs and through purchases, usually without a title.

Farmers with more than one field often obtained land in multiple ways. In Table 3b, we report the source for the household's largest field. Of the eight categories, we expect that households who bought land and who participated in government programs will have higher income than others. Both the market and the government may have selected for farmers that are wealthier or abler and who have better income prospects in the future. A competing hypothesis is that land in these two categories is higher quality. The act of borrowing fields may also be an indication of farmer initiative to expand the area cultivated. If true, the borrowing and renting variable is likely to be signed positively.

3.5. Trees and Livestock

Aside from land, trees and livestock are the main agricultural assets in rural Mozambique. For the two common tree crops and three most important types of livestock, we divided the households into three groups: those who did not own the asset, those who owned some of the asset, and those who owned enough of the asset to be considered a specialized producer (Table 3c). The cutoff point distinguishing some and a lot was arbitrarily set at the 95th percentile of the tree or livestock number in the sample. In other words, the last dummy variable category contained the (unweighted) 5% of households who possessed more of the asset in question.

Since colonial times, cashew production has been a very important cash crop in Mozambique, and smallholders are the dominant producers. About one-third of the households possessed cashew trees, and our threshold point at about the 95th percentile was 60 or more trees. Coconuts are important in the coastal provinces. About 5% of the households had access to 20 or more trees. A majority of households also had fruit trees although the number of these trees was not estimated in the TIA. We expect that more extensive holdings of commercial tree crops will translate into higher income, particularly for more specialized cashew and coconut producers.

Livestock, particularly cattle, are less important in Mozambique than in most other African countries. The lack of importance is usually attributed to herd depletion caused by 15 years of civil war and to tsetse fly infestation. In the TIA 2002, the three most important species were goats, cattle, and chickens. Holdings of sizable numbers of cattle (10 or more), goats (20 or more), and chickens (30 or more) should be positively associated with income (Table 3c).

Table 3c. Description of the Productive Asset Variables

Variable category		Description	Sample mean		
			Unweighted	Weighted	Expected sign
General	**Specific**				
Dependent		ln household income	5.165	4.992	
		ln household income per capita	3.614	3.528	
Independent					
Productive Assets	Trees	Some cashews (1-60)	.291	.319	
		Many cashews (>60)	.056	.052	+
		Some coconuts (1-20)	.102	.126	
		Many coconuts (> 20)	.058	.074	+
		Fruit frees (>1)	.704	.674	+
	Livestock	1-9 head of cattle	.054	.032	
		More than 10 cattle	.081	.008	+
		1-19 goats	.324	.255	
		More than 20 goats	.042	.010	+
		1-29 chickens	.630	.616	
		More than 30 chickens	.054	.041	+
	Other assets	Radio	.531	.492	+
		Bike	.253	.228	+
		Oil lantern	.536	.550	+

[1] Reference category for dummy variables.

3.6. Other Assets

In addition to land, trees, and livestock, many household owned radios, bicycles, and oil lanterns that qualify as productive assets. About one-half of the households had radios and oil lanterns and one-quarter possessed bicycles (Table 3c). Ownership of these assets may reflect higher income in the past and may be used to enhance income in the future.

3.7. Access to Information

Access to information should translate into economic gain and thus partially explain the variation in household income. Alternatively, access to information may be an indicator of higher income independently of any effect on present income. We focus on three information-related variables: (1) membership in an organization, (2) access and receipt of information on agricultural extension, and (3) access and receipt of information on commodity prices. The latter two are measured both at the household and community level. Agricultural extension includes both the government and NGOs. Estimated household coverage for agricultural extension was 15% (Table 3d). Only about one household in thirty belonged to an organization,

Table 3d. Description of the Technology and Institution Variables

Variable category		Description	Sample mean		Expected sign
			Unweighted	Weighted	
General	**Specific**				
Dependent		ln household income	5.165	4.992	
		ln household income per capita	3.614	3.528	
Independent					
Organization and information	Association	Member of an organization	.049	.036	+
	Extension	Received extension information: household level	.144	.135	+
		Received extension information: community level	.348	.322	+
	Price	Received price information: household level	.305	.347	+
		Received price information: community level	.375	.347	+
Technology	Mechanization	Animal traction	.199	.111	+
		Tractorization	.052	.027	+
		Mechanized pump sets/engines	.014	.0043	+
	Cash crops	Grows cotton	.064	.071	+
		Grows tobacco	.040	.037	+

[1] Reference category for dummy variables.

usually a farmer's association, however, one household in three said that they received information on agricultural prices. At the community level, about one-third of the focus groups in the villages stated that they had access to information on agricultural extension and on commodity prices.

3.8. Access To and Use of Technology

Several technologies are unavailable to farmers or availability is spatially limited. For example, the use of animal traction is largely confined to the higher altitude areas of higher population density in Northern and Central Mozambique and to dryer Southern region where cattle density is greater. Tsetse fly is endemic in lowland areas in the wetter northern and central regions. About 50% of animal traction used in the sample is owned; the other 50% is rented from others.

Inorganic fertilizer and pesticide use is mainly linked to contractual schemes that grow cotton and tobacco in well-defined concessional areas. The company granted the concession arranges input supply. Outside the concessional area, the supply of improved inputs and technological know-how may not be forthcoming. Market access to tractors and to pump-sets and engines may also be spatially and seasonally restricted. Although the use of inputs and crop choice are usually viewed as endogenous decisions partially determined by other independent variables that also explain income, their restricted access in Mozambique motivates us to include some of these variables directly as regressors. Only a minority of farmers employed these improved mechanical and animal technologies ranging from 0.4% using mechanized pump-sets and

engines to 11% using animal traction. About 4-7% of households grew tobacco and cotton, respectively. Because richer households are the first to adopt these lumpy mechanical and animal traction technologies, we expect a strong association with income. Likewise, producers of cash crops, especially tobacco, a high-paying, knowledge- and labor-intensive crop, are expected to have income superior to their peers.

3.9. Other Demographic Determinants

Aggravated by 15 years of civil war, Mozambique has endured an arduous and, at times, chaotic history of village resettlement. Three variables are potential candidates for cataloging this history to separate and identify income variation by household (Table 3e). About 60% of the heads of household were born in the same village. These households may have more established land use rights than more recent immigrants who, on the other hand, seem better-educated and more mobile with improved access to some off-farm income opportunities. Ceteris paribus, it is difficult to predict which group is better positioned to generate higher levels of income. Including this variable is more in the spirit of holding other things constant. A priori reasoning is stronger in signing coefficients for older villages established prior to independence in 1974, and villages where families live closer together. Village age and compactness suggest higher population density that should be positively associated with economic development.

3.10. Community-Level Infrastructure

Eleven community-level variables are specified to measure the quantity and quality of infrastructure at the community level (Table 3e). Four of the variables attempt to measure road infrastructure; the other seven are related to diverse aspects of infrastructure that could add to the variation in household income across the 559 villages in the sample. These eleven variables were selected from a candidate list of 30 to 40 potential (and often overlapping) variables that could be constructed from the community questionnaire to proxy for multiple dimensions of community infrastructure. The selection criteria included a priori reasons for expecting a strong association, sufficient observations within groups to allow meaningful estimation, and statistically significant within-group differences in mean household income. We expect that positive scores on all these variables will confer economic benefits to the residents of these communities.

3.11. Agricultural and Health-Related Risks

Agricultural production in Mozambique is vulnerable to diverse sources of risk. Recent unwanted visitors included drought in 2002-03, flooding in 2000-01, and persistent and pervasive plant and animal diseases in most years. We constructed four community-related risk variables that are based on recall information from the recent past (Table 3f). Focus-group participants were asked to classify the prior 4 years and 2001-2002 in a risk rating from 0 (no occurrence) to 5 (all families affected) for four sources of risk: flooding, drought, crop pests and diseases, and animal diseases. The mean scores in Table 2 show that some village respondents said that they had a severe occurrence every year with the exception of flooding. At the other extreme, some village groups stated that the source of risk did not occur in any of the five years. Drought is more widespread than flooding, but both are substantially less than the risk of animal

disease, mostly Newcastle's disease in chickens. We anticipate negative estimated coefficients on these variables and that the coefficient on drought would be significantly larger than the others.

Table 3e. Description of the Village Demographic and Community Infrastructure Variables

Variable category		Description	Sample mean		Expected sign
			Unweighted	Weighted	
General	**Specific**				
Dependent		ln household income	5.165	4.992	
		ln household income per capita	3.614	3.528	
Independent					
Village-Related Demographic		Born in village	.615	.642	?
		Age of village (before independence = 1)	.614	.584	+
		Live close together	.649	.628	+
Community Infrastructure	Roads	Paved	.187	.186	+
		Open throughout year	.659	.659	+
		Bus throughout year	.262	.273	+
		Less than 10 km to Center[1]	.402	.415	
		11-20 kms or 1 hour to Center	.158	.162	-
		21-40 kms or 2-3 hours to Center	.176	.181	-
		More than 40 kms or 3 hours	.210	.203	-
		Missing info on distance	.054	.039	
	Electricity	Access	.083	.078	+
	Wells	In or nearby = 1	.681	.710	+
	Market	In the Village = 1	.283	.308	+
	Factory	In the Village = 1	.029	.026	+
	Input supply store	In the Village = 1	.136	.144	+
	Water points for livestock	Nearby = 1	.189	.136	+
	Formal credit programs	Access to = 1	.118	.103	+
	Village processing	Maize mill in the Village = 1	.370	.339	+

[1] Reference category for dummy variables.

Restocking seed in times of emergency is one of the government's responses to mitigate agricultural risk. About 650 households received "emergency" seed in 2001-2002. We expect that these households would be poorer than others if they qualified for free seed on a needs basis.

Health-related risks also take a toll on households in Mozambique that has one of the highest rates of infant mortality of any country in the world. Malaria is endemic, and HIV-AIDS is increasing. "Did any family member die in the past two years?" and "Is any family member suffering a prolonged illness?" are two questions in the TIA 2002 that speak to health risk. About 5% of the households answered affirmatively (Table 3f). We expect death and prolonged illness to negatively affect household income.

Table 3f. Description of the Production Potential and Risk Variables

Variable category		Description	Sample mean		Expected sign
General	**Specific**		**Unweighted**	**Weighted**	
Dependent		ln household income	5.165	4.992	
		ln household income per capita	3.614	3.528	
Independent					
Risk	Production	Flood index	.517	.502	-
		Drought index	.998	.846	-
		Plant pests or diseases index	1.635	1.563	-
		Animal diseases	2.760	2.954	-
		Received emergency seed	.127	.083	-
	Health	Death of adult (past two years)	.044	.042	-
		Prolonged illness	.067	.069	-
Production potential	Crop diversity	Only 1 crop cultivated in village[1]	.053	.032	
		2-10 crops	.531	.482	+
		11-20 crops	.349	.389	+
		More than 20 crops	.068	.096	+
Other	Data correction	Underestimate self-emp. Income	.014	.010	-
	Off-farm emp.	No. members with wage income	.305	.242	
		No. members self-emp. off farm	.490	.478	
	Agroecology				
	2	Dry SAT, coastal southern	.142	.124	-
	3	Dry SAT, south interior	.125	.053	-
	4	Wet SAT, mid-elevation central	.086	.073	+
	5	Wet SAT, central coast[1]	.0991	.137	+
	6	SAT, Zambezia Valley, south Tete	.140	.104	?
	7	Wet SAT: mid-elevation north-central	.189	.220	+
	8	SAT, coastal north-central	.135	.211	+ ?
	10	Wet SAT, high altitude north-central	.083	.078	+

[1] Reference category for dummy variables.

3.12. Production Potential and Spatial Variation

Two variables were specified to capture differences in production potential (Table 3f). One of the questions in the community questionnaire asked via a checklist of 27 choices how many crops were grown in the village. More species cultivated should reflect greater production and market potential.

The other spatial productivity measure was more conventional: a classification of agro-ecologies drawn up by the national agronomic research institute (INIA). We expect rural income to be higher in the wetter agro-ecologies in the central and northern regions compared to the dryer South. The original 10 agro-ecologies were combined into eight so that each aggregated grouping had at least 5% of the observations.

We include district variables to control for any other spatially related factors. Eighty of Mozambique's 125 districts were sampled in TIA 2002. For space reasons, we do not present the estimated district effects in the regressions that follow.

4. DETERMINANTS OF HOUSEHOLD INCOME: INTERPRETING THE RESULTS

We explain about 40% of the variation in household income (Table 4). Many of our expectations were confirmed, but Table 4 also contains its share of surprising results. Changing the dependent variable from household to per capita income did not affect most of the findings. The one exception, which was anticipated, pertained to the contribution of family size to per capita income. The family member variables were all negatively signed and highly statistically significant in the per capita equation presented in the second column of Table 4. The age composition coefficients also performed as expected, significantly more negative for younger family members than for adults who generate the bulk of income for the household.[5] Because of the similarity of results for household and per capita income and because of likely economies of household size, we discuss only the findings for household income in the rest of this section.

4.1. Gender, Age, Family Size, and Education

Women-headed households are significantly disadvantaged in income compared to households headed by men (Table 4). This finding applies particularly to widow-headed households who had 30% less income than male-headed households. Ceteris paribus, switching from a male-headed to a widow-headed household was accompanied by the same absolute size of income effect as shifting from our highest educational attainment level to illiteracy. The severe income penalty for widows compared to the moderate disadvantage for women heads who are non-widows suggests two different populations of women farmers for gender-related programs. Any policy or program that reduces the incidence of widow-headed households will reduce income poverty.

Somewhat surprisingly, the income profile for age was flat: no statistical significance and no category displaying more than a 1.5% difference in income from our reference group of young farmers. More in line with expectations, very young children were associated with a small but statistically significant decline (4%) in household income. Older children between age 5-14 were characterized by a small, but, statistically significant improvement in income prospects. Adding a man to the household was correlated with a significantly greater gain in income than adding a woman to the household. More schooling was identified with higher income. Nonetheless, at least three years of schooling were required to confer a statistically significant advantage in income. The small minority of households with heads who have five or more years of schooling were clearly separated from the large majority of less educated households.

4.2. Land

Operated area significantly affected income. Although the coefficients of the farm size categories are some of the largest in absolute value in Table 4, our overall estimate of a 45% increase in income between the 20% of households with the smallest farm size and the 10% of households with the largest amount of cultivable area does not seem inordinately large. As we shall see in the next section, off-farm income plays a role in shrinking the income gap between these two farm size groups.

[5] Strangely, this estimated differentiation in size of household composition coefficients was not obtained by Datt et al. 2000 in their analysis of consumption expenditure. Their estimated coefficients did not differ significantly among age and gender groups.

Table 4. Determinants of Rural Income[1] in Mozambique, 2001-2002 (OLS estimates on Ln income)

	Estimated Coefficients[2]			
	Household Income		Per capita Income	
Independent Variable	Coefficient	t-statistic	Coefficient	t-statistic
Woman-headed household, not a widow	-0.140	(3.57)**	-0.091	(2.31)*
Household headed by a widow	-0.304	(6.06)**	-0.160	(3.44)**
Age of head 30-39	0.010	(0.19)	-0.001	(0.02)
Age of head 40-49	-0.012	(0.21)	-0.011	(0.18)
Age of head 50-59	0.013	(0.22)	0.059	(0.93)
Age of head older than 60	-0.013	(0.17)	0.089	(1.17)
Schooling 1-2 years, base is 0 years	0.010	(0.20)	0.009	(0.17)
Schooling 3-4 years, base is 0 years	0.120	(2.92)**	0.129	(3.28)**
Schooling 5 or more years	0.308	(5.15)**	0.327	(5.46)**
Family members aged 0 to 4	-0.039	(2.01)*	-0.231	(11.77)**
Family members aged 5 to 14	0.030	(2.40)*	-0.180	(14.35)**
Male adults aged 15 to 64	0.114	(4.98)**	-0.062	(2.68)**
Female adults aged 15 to 64	0.077	(3.81)**	-0.104	(4.43)**
Family members 65 and older	0.044	(1.03)	-0.148	(3.31)**
Farm size, 0.75-1.745 has.	0.204	(5.00)**	0.185	(4.64)**
Farm size, 1.75-4.998 has.	0.344	(5.97)**	0.334	(6.03)**
Farm size, 5.0 or more has.	0.458	(4.38)**	0.474	(4.76)**
Irrigation, one or more fields, (0-1)	0.168	(4.47)**	0.182	(4.81)**
Upland fields, base is all lowland fields	0.009	(0.22)	0.008	(0.18)
Both upland and lowland fields	-0.042	(1.06)	-0.041	(1.01)
Could obtain land, if wanted to (0-1)	0.053	(1.08)	0.068	(1.40)
Easy to obtain land in village (0-1)	0.023	(0.45)	0.016	(0.31)
No fields, base is 1 field	0.437	(1.35)	0.355	(1.02)
Two fields, base is 1 field	0.133	(2.92)**	0.109	(2.32)*
Three-four fields, base is 1 field	0.233	(5.05)**	0.199	(4.31)**
Five or more fields, base is 1 field	0.368	(5.83)**	0.366	(5.85)**
Land source[3]				
2	0.222	(1.52)	0.189	(1.35)
3	0.037	(0.52)	0.026	(0.38)
4	0.175	(1.80)	0.138	(1.45)
5	0.114	(1.72)	0.107	(1.72)
6	0.335	(3.01)**	0.310	(2.78)**
7	0.012	(0.14)	0.013	(0.15)
8	-0.133	(0.66)	-0.052	(0.28)
1 to 59 cashew trees (0-1)	0.030	(0.62)	0.028	(0.63)
60 or more cashew trees (0-1)	0.125	(1.94)	0.090	(1.29)
1 to 19 coconut trees, base is 0 trees	0.063	(1.31)	0.026	(0.53)
20 or more coconut trees, base is 0 trees	0.265	(3.36)**	0.245	(2.92)**
one or more fruit trees	0.017	(0.34)	0.001	(0.01)
Own a radio (0-1)	0.202	(7.18)**	0.172	(5.90)**
Own a bicycle (0-1)	0.261	(5.76)**	0.258	(5.75)**
Own an oil lantern (0-1)	0.209	(5.48)**	0.203	(5.30)**
Used animal traction (0-1)	0.084	(1.39)	0.077	(1.27)
Used a tractor, pick-up, or truck (0-1)	0.526	(4.13)**	0.522	(3.95)**
Used oil engines or electric pumpsets (0-1)	0.253	(1.31)	0.191	(0.97)
Cultivated cotton (0-1)	0.050	(0.88)	0.053	(0.88)
Cultivated tobacco (0,1)	0.284	(4.16)**	0.264	(4.02)**
Belong to an association (0-1)	0.121	(1.75)	0.131	(1.93)
Received information from extension (0-1)	-0.031	(0.71)	-0.021	(0.50)
Extension info. available in village (0-1)	-0.042	(0.83)	-0.036	(0.72)

Table 4. Determinants of Rural Income[1] in Mozambique, 2001-2002 (OLS estimates on Ln income) Con't.

	Estimated Coefficients			
	Household Income		Per capita Income	
Independent Variable	Coefficient	t-statistic	Coefficient	t-statistic
Received information on prices (0-1)	0.107	(2.87)**	0.124	(3.34)**
Info. on prices available in village (0-1)	0.025	(0.50)	0.012	(0.23)
Old village before Independence (0-1)	-0.096	(2.13)*	-0.087	(1.86)
Houses in village are close together (0-1)	0.119	(2.15)*	0.116	(2.09)*
Born in the village (0-1)	-0.036	(1.02)	-0.024	(0.67)
Live near a paved road (0-1)	-0.034	(0.55)	-0.057	(0.90)
Passable road throughout year	0.063	(1.35)	0.064	(1.30)
Bus transport throughout the year (0-1)	-0.024	(0.51)	-0.032	(0.71)
11-20 kms or 1 hour to Center	-0.079	(1.33)	-0.098	(1.66)
21-40 kms or 2-3 hours to Center	-0.016	(0.30)	-0.013	(0.24)
More than 40 kms or 3 hours to Center	0.013	(0.21)	0.015	(0.25)
Missing information on distance to Center	-0.093	(1.19)	-0.084	(0.93)
Access to electricity in village (0-1)	0.115	(1.48)	0.113	(1.54)
Access to well water in or near village (0-1)	0.009	(0.18)	0.018	(0.37)
Access to a market in or near village (0-1)	0.046	(1.04)	0.046	(1.06)
Factory in the village (0-1)	0.200	(1.35)	0.225	(1.50)
Input supply store in the village (0-1)	0.072	(1.57)	0.074	(1.60)
Water points for cattle in the village (0-1)	0.103	(1.81)	0.101	(1.81)
Access to formal credit in the village (0-1)	0.019	(0.35)	0.020	(0.36)
Maize mill in the village (0-1)	0.067	(1.47)	0.059	(1.25)
Adult death in past two years	0.005	(0.06)	-0.012	(0.14)
Adult prolonged illness	-0.015	(0.24)	-0.016	(0.28)
Flood risk (index 0-5)	-0.041	(1.05)	-0.041	(1.02)
Drought risk (index 0-5)	-0.033	(2.09)*	-0.035	(2.09)*
Plant pest and disease risk (index 0-5)	-0.035	(2.35)*	-0.032	(2.17)*
Animal disease risk (index 0-5)	-0.005	(0.32)	-0.005	(0.32)
Received emergency seed (index 0-5)	0.149	(3.12)**	0.126	(2.67)**
Crops grown in village: 2-10, base is 1	0.177	(2.31)*	0.184	(2.32)*
Crops grown in village: 11-20, base is 1	0.236	(2.54)*	0.238	(2.45)*
Crops grown in village: > 20, base is 1	0.361	(3.08)**	0.368	(3.02)**
Underreported self-employment income	-0.314	(2.01)*	-0.292	(1.96)
1-9 head of cattle	0.111	(1.00)	0.072	(0.71)
10 or more head of cattle	0.465	(4.05)**	0.568	(5.43)**
1-19 goats (0-1)	0.023	(0.67)	0.015	(0.45)
20 or more goats (0-1)	0.477	(3.03)**	0.518	(3.34)**
1-29 chickens (0-1)	0.086	(3.34)**	0.057	(2.05)*
30 or more chickens (0-1)	0.214	(2.60)*	0.199	(2.31)*
Agroecology[3]				
2	0.696	(7.74)**	0.678	(6.90)**
3	-0.294	(2.83)**	-0.420	(4.06)**
4	0.023	(0.16)	0.000	(0.00)
6	-0.003	(0.02)	-0.001	(0.01)
7	-0.429	(2.27)*	-0.507	(2.68)**
8	0.250	(1.76)	0.228	(1.52)
10	0.724	(6.87)**	0.608	(5.66)**
Constant	3.103	(19.00)**	2.635	(15.89)**
Observations	4833		4833	
R-squared	0.41		0.37	

[1]At an exchange rate of US$1 =23,540 meticais.
[2]Absolute value of t statistics in parentheses = * significant at 5%; ** significant at 1%.
[3]Land Sources and Agroecologies are defined in Table 2.

Perhaps the most striking part of the land "story" reflected in Table 4 is the statistical importance of number of fields, independently of farm size. There was not a statistically significant difference between households who did not farm a field and our reference group of households with one field. About 1% of the sample did not cultivate land. They were a diverse lot including both richer and poorer farm households. For the cultivators, increasing the number of fields from one to five or more was steadily associated with higher levels of income. Farmers who only have one field were substantially worse off than other producers. Increasing number of fields from one to two was accompanied by a 13% increase in household income. In Mozambique, where hand-hoe agriculture is the dominant mode of cultivation and where estimation of area is imprecise, number of fields seems to be an important indicator of rural welfare and commitment to farming. (It is surprising that potential multicollinearity between farm size and field number did not result in the statistical insignificance of one or both of these variables).

The insignificance of field location was another unexpected finding. The results on location of the field in an upland or lowland setting did not contribute significantly to explaining the variation in household income. Having both upland and lowland did not yield an economic advantage. The absence of significant difference between upland and lowland fields hints at problems in measurement of production in the second season when lowland fields are more likely to be cultivated.

Use of irrigation was strongly correlated with household income. The land scarcity variables at both the household and community levels also performed as expected although they were not statistically significant. Having "easy" access to land was associated with a 5% increase in household income.

The estimated coefficients on the land transactions variables also behaved as expected. Those who said they bought their largest field (land source) had income superior to other households that used other means to obtain land. The size of the estimated coefficient on land transactions via formal authorities (government) is consistent with selection of higher income households or settlement on more productive land or both, but more observations are needed for statistical significance to arrive at that conclusion. Households who borrowed land from others also have substantially higher income with borderline statistical significance.

4.3. Productive Assets

A scattered holding of cashew and coconut trees below a threshold size (equivalent to 5% of growers with the largest number of trees) did not confer a significant economic advantage. Larger holdings did result in increased income, but coconut producers were better off than cashew growers. Ceteris paribus, households with 20 or more coconut trees had higher income than households with 60 or more cashew trees. The size of the estimated coefficient for holdings of 60 or more cashew trees points to stagnating productivity. Ownership of 60 or more cashew trees should have translated into an income advantage greater than 12.5%. Our 0-1 fruit tree variable was too crude to make a positive contribution to explaining the variation in household income, probably because on-farm consumption of fruit crops was not valued.

The livestock-related variables performed as expected. Households with appreciable numbers of goats, cattle, and chickens were characterized by significantly higher income. More specialized poultry producers do not seem to earn as much as similarly specialized goat herders and cattle ranchers; however, there is a statistically significant income advantage to owning

some chickens. Even smallholdings of small livestock can make a difference in income. Two-thirds of the sample own some chickens. And the documented significance of the estimated coefficient for "some chickens" confirms the potential of programs such as the prevention of Newcastle's disease to contribute to poverty alleviation in rural Mozambique.
Ownership of radios, bicycles, and oil lanterns were all significant correlates of household income. Each of these productive assets is also a consumer durable and was characterized by a large estimated coefficient. Their large magnitude between .19 and .26 suggests that these variables are positively associated with other variables that were not measured in the survey.[6]

4.4. Organizations and Information

The findings on these five variables are mixed. As expected, higher income farmers are more likely to be members of associations that in turn may lead to higher income. Households who received price information realized an 11% income advantage over those who did not receive such information. Radios are also included as an independent variable; therefore, this result seems to be a reasonably pure consequence of access to price information. Again, the alternative hypothesis is that other variables that positively impact on income are associated with the receipt of price information.

Agricultural extension was a major surprise: signed negatively and statistically insignificant. Absence of statistically significant positive results on both the community and household variables suggest that extension messages are not making a difference in rural income. Multiple explanations could be offered for why extension information may not be affecting rural income. Constraints on access to improved inputs and to more location-specific adapted technologies could figure prominently among these reasons. On a more positive note, this result does not substantiate the claim that NGO and public sector extension specialists are working mainly with richer farmers. More detailed information on technological change and on agricultural extension is warranted in future TIAs.

4.5. Mechanization and Cash Crops

The estimated coefficients for these variables are all signed positively, as expected, but statistical significance is more variable than anticipated. The absence of statistical significance for growing cotton is most likely attributed to the depressing downward trend in cotton prices abetted by powerful lobbying of several joint venture companies that often result in the lowest cotton prices in Southern Africa (Boughton et al. 2002). Low prices beget low productivity that further impoverishes cotton farmers. In contrast, households that contracted to grow tobacco have significantly higher income than other rural households. Richer farm households are usually the first ones to use animal traction and tractors that, in turn, generate income benefits via area expansion. The size of the coefficient for tractor use is impressive but is relevant for barely 3% of the rural population. The estimated coefficient and statistical significance of animal traction use is substantially more modest than expected, but, as pointed out above, that could be the result of including other assets in the model. The absence of statistical significance

[6] If we treat these assets as past income outcomes and drop them from the estimating equation, the estimated coefficients of the other productive assets increase slightly. The coefficient on animal traction is the most sensitive coefficient to the inclusion or exclusion of radios, bicycles, and oil lanterns. Including these assets confers a statistically insignificant 8% income advantage on animal traction households; excluding them yields a statistically significant estimated coefficient equivalent to a 13% increase in household income. Overall explanatory power drops from 0.41 to 0.39.

on mechanized motors is probably explained by lack of variation in this category: few farmers own and therefore have access to the use of these machines.

4.6. Village-related Variables and Community Infrastructure

Holding other variables constant in a regression context, household income was not significantly different for immigrants and indigenous villagers. The negative sign suggests higher income for immigrant households who are more educated and have more off-farm income; the native-born have more land. Controlling for these influences in the other variables, a significant residual difference between the two groups did not emerge.

The estimated coefficients on the two village demographic variables generated in the community questionnaire are almost equal in absolute value (.10-.11). But, unexpectedly, households in older villages (founded prior to independence) have significantly lower income than households in more recent villages. Perhaps declining soil fertility in the older villages plays a role in explaining this disparity in income. As expected, more compact villages are characterized by higher household income than more extensive communities.

In general, our eleven community infra-structural variables did not play a major role in explaining the variation in rural household income. Only the input supply store and watering points for cattle in the village approached statistical significance at the 5% level. The absence of explanatory power in the four proxies for transport access and distance is particularly disappointing in a country where roads feature so prominently in the public sector and donor investment portfolios. This insignificant result on road infrastructure points to the need to revisit the community questionnaire to search for other proxies that may better reflect the variation in transport development. In future TIAs, the theme of road infrastructure needs to be addressed with more incisive questioning. These results are also similar to those for Datt et al. (2000) who found that variables measuring economic infrastructure at the community level did not significantly explain the variation in household consumption expenditure. This lack of statistical significance prompted Datt et al. (2000) to amalgamate all their community-variables into an index of economic infrastructure.

4.7. Risk-related Considerations

Health risk in the form of an adult death or prolonged adult illness did not generate transparent income consequences that were captured in our general regression analysis. More detailed analysis of these two aspects is contained in Mather et al. 2004.

All three sources of risk that were related to plant production were characterized by estimated coefficients of approximately the same size: a unit increase in the risk index translated into a 3-4% decrease in income. These effects, although statistically significant for both drought and plant pests and diseases, were milder than expected. Taken together, they suggest that 2001-2 was not that “bad” a year for agricultural production.

Unexpectedly, farmers who received emergency seed had significantly higher income than others. Either seed supply was truly constrained and emergency seed “worked” or, more plausibly, beneficiaries were richer than non-beneficiaries at the start of the program.

4.8. Production Potential: Crop Diversity and Agro-ecology

Villages where more species are sown had significantly higher income than villages where few, particularly only one or two, crops were cultivated. Most of the villages with limited crop diversity were located in the dryer South. In contrast, the pattern in estimated responses to agro-ecology does not bear out our earlier thinking. One of the agro-ecologies with less production potential – the southern coast with a dry Semi-Arid Tropical rainfall regime – is characterized by significantly higher income than most of the other agro-ecologies. The high altitude North-Central region also stands out as a high-income agro-ecology.

5. EXPLAINING THE VARIATION IN THE SOURCES OF INCOME

In this section, we take a deeper look at the variation in household income by assessing the determinants of the most important sources. We examine seven sources: (1) net crop income, (2) livestock income, (3) off-farm self-employment, net small-business income, (4) off-farm self-employment, resource-extraction income, (5) off-farm agricultural wage income, (6) off-farm non-agricultural wage income, and (7) net remittance income.

Off-farm self-employment income was divided into two parts to separate small business enterprises from natural resource extraction activities that includes hunting, fishing, felling trees for charcoal, wood cutting, and foraging. The former is about twice as important as the latter in value terms. The importance of different determinants is likely to vary markedly across these two groups. Likewise, we divided off-farm wage employment into two groups, agricultural and non-agricultural. Each was about equally likely in the TIA 2002, but the estimated income share of non-agricultural earnings was about 10 times as large as agricultural wage income that is a more temporary source of employment.

We use OLS to estimate the determinants of the natural log of net crop income. The majority of households did not participate in or receive income from the other six sources; therefore, we invoke a tobit-estimating procedure to assess the determinants of these six sources. The number of observations is 4,833 except for the regression on net crop income for which negative and zero observations were eliminated because of the logarithmic transformation of the dependent variable. In both the OLS and tobit estimations, the observations are weighted by their representativeness according to the sample design.

The determinants are largely the same as those we described in Table 3a through 3f. Depending on the source, we also include the number of family members reporting a primary occupation in an income source different from agriculture. This variable is included to test for interactions between different sources of income. Because of problems of collinearity, i.e. no variation in the dependent variable, we only included district variables as regressors in the net crop income equation. In the livestock equation, we deleted the variables related to livestock inventories that are closely associated with livestock income.

Different sources of household income could be simultaneously determined leading to biased estimated coefficients. During a cropping year, it is likely that several sources are determined recursively, i.e. a shortfall in crop income induces more effort to participate in the temporary agricultural wage market or, more likely, to chop down trees for later sales of charcoal to smooth income and consumption. In any case, these regressions should be viewed as exploratory; modeling the structural determination of household income is beyond the scope of this paper.

The results of the statistical analysis on sources of income are presented in Appendix Table 1. Rather than discuss each income source separately, we integrate the results across sources by returning to the determinant grouping of the previous sections.

5.1. Women-headed Households

The estimated coefficients in Appendix Table 1 are signed negatively for women-headed households for five of the seven income sources. Widows are significantly poorer in crop income than other households (Appendix Table 1). Women-headed households receive

substantially less income than male-headed households from off-farm self-employment, focused on resource extraction, and off-farm non-agricultural wage earnings (Appendix Table 1). Significantly higher remittances did not compensate for lack of participation in the above-mentioned two sources that are dominated by men.

5.2. Age of the Head

In general, age of the head is not a statistically significant determinant of the variation in crop or livestock income (Appendix Table 1). Years of war may have wreaked havoc with asset accumulation over time, commonly observed in other countries, that gives rise to life-cycle effects.[7] In contrast, age differences play a significant role in explaining the variation in several of the non-farm sources of income. In particular, extractive self-employment activities and agricultural wage employment require greater physical effort and are the domain of younger men as evidenced by negative estimated coefficients in all the older age groups. Older household heads also earn less income from off-farm small business activities. As expected, remittances and pensions favor the elderly. Overall, younger households are more heavily engaged in off-farm income earning activities than older households.

5.3. Schooling of the Head

Returns to schooling vary markedly by source. Positive covariate outcomes with schooling are most pronounced in small-business self-employment and in non-agricultural wage employment (Appendix Table 1). More educated household heads are significantly less likely to engage in and earn remuneration from extractive self-employment activities and from agricultural wage employment. Neither crop or livestock income is significantly associated with the level of schooling. This finding leads to the inference that returns to schooling are low in agriculture. However, in other work, we find that investment in the form of cash costs in crop production is significantly associated with schooling. And the interaction between crop income and off-farm self-employment is positive (Appendix Table 1) suggesting that schooling may work indirectly through off-farm self-employment to generate funds for investing in agriculture.

Nonetheless, the absence of statistical significance of schooling on agricultural and livestock income is puzzling and potentially worrying. It suggests a technologically stagnant agriculture where increased capacity to process information from schooling is not a demonstrable advantage. Even remittance income appears to respond favorably to education (Appendix Table 1).
A finding of insignificant returns to rural education in African agriculture is not unique to Mozambique (Philips 1986). In Ghana, the largest impact from rural education was increased off-farm income; consequently, better-educated farmers allocated more time to pursue off-farm activities (Joliffe 2004).

[7] Regression results on cultivated area do suggest statistically significant but mild life cycle effects. Cultivated area increases with age and peaks when the head reaches 50-59. Household heads in their forties and fifties plant about 10-15% more land (equivalent to about one-fifth of a hectare) than younger household heads in their twenties and thirties.

5.4. Composition of the Family

Adolescents and older children participate in and earn income from crops, livestock, self-employment extractive activities, and off-farm agricultural employment, but the estimated coefficients in Appendix Table 1 are not large and are not statistically significant. Earlier, we documented in Table 4 that an additional man aged (15-64) increased household income by 12% compared with 8% for an additional woman. Ceteris paribus, men earn somewhat more than women from multiple sources, but only in extractive self-employment and in agricultural wage employment are the gender-related differences in the estimated coefficients statistically significant.

5.5. Land

The estimated coefficients on many of the agriculturally related determinants are significantly higher in the regression on crop income in Appendix Table 1 than in the regression on household income in Table 4. Farm size is an apt example; the estimated coefficient of the largest farm-size category in Appendix Table 1 suggests an 87% advantage in net crop income over the smallest size grouping. This differential is approximately double the size of the comparable result in Table 4. Independently of farm size, number of fields also is an important variable in accounting for the variation in net crop income. Ceteris paribus, households with two fields had 25% higher crop income than those with one field.

Farm size does not play a significant role in explaining the variation in the off-farm income sources. In an analysis of 960 households in northern and central Mozambique, Tschirley and Benfica (2000) encountered a similar but more specific result: farm size in number of fields did not explain participation in the high wage-end of the non-agricultural labor market. They also found that education was an important determinant in the high-wage segment of the rural labor market and that the interaction with agricultural income was limited. Both of these findings support the TIA 2002 results.

Farm size also seems to affect crop and livestock income differently. Across our four farm size groups, crop income is significantly more responsive to farm size than livestock sales.

Communities where farmers said that it was easy to obtain more land had significantly higher net crop and livestock income (Appendix Table 1). But the same land-abundant communities had significantly lower receipts from agricultural wage employment, which is to be expected if cultivating land yourself is more profitable than wage labor.

We also uncovered a connection between self-employment income and land transaction type. Households whose largest field was purchased or borrowed had higher self-employment small business income than others. Thus the land market appears to be one venue for the positive interaction between off-farm self-employment and agriculture. Land ceded by the government (land source=2) also had 15% higher net crop income than land assigned by traditional authorities (land source=1).

5.6. Asset Ownership

The importance of bicycles, radios, and oil lanterns is reflected in significant estimated coefficients for net crop income. As discussed previously, some of these effects may be due to

the correlation of the ownership of these assets with other unobserved characteristics that determine more fundamentally these sources of income. Bicycle ownership is strongly correlated with net crop income and small business income. This is consistent with the commonly observed practice of farmers using cash crop sale earnings to purchase bicycles that are subsequently used for commercializing farm products and participating in petty trade.

5.7. Technology

Use of animal and mechanical land preparation technologies and participation in contractual arrangements to grow cash crops gave results consistent with expectations. Users of animal traction have significantly higher livestock sales; tractor users are significantly richer than other households owing to substantial advantages in net crop, livestock, and small business income. Cotton farmers rely heavily on crop income; their participation in livestock activities, resource extraction, and off-farm non-agricultural wage income is limited. Indeed, the lack of income diversification in the cotton sub-sector is a cause for concern. The weak linkage between livestock and cotton production does not bode well for intensification.

5.8. Information and Organization

The results in Appendix Table 1 point to a mild association between extension contact and crop income. Both extension variables at the household and community levels tend towards a low level of statistical significance and are consistent with about a 5% gain in net crop income. On the other hand, extension contact does not do much for livestock income. Extension effort seems to focus on crop cultivation. Or efforts to provide a unified polyvalent extension service have not yet borne fruit.

Belonging to association is itself associated with the accrual of income from crop and livestock activities. The absence of statistical significance for the other income sources suggests that the benefits from belonging to an association are mainly restricted to agriculture or that farmers participating in these organizations do not have widely diversified income sources.

The importance of price information inferred from the results in Table 4 is described in greater detail in Appendix Table 1. The effect of receipt of price information on net crop income and livestock sales is less than on household income, and the statistical significance of the coefficient also declines. Having price information is characterized by significantly higher small-business self-employment, an income source that presumably makes good use of such information.

5.9. Community Infrastructure and Village Variables

Judging from the size of the coefficients, off-farm non-agricultural wage income was characterized by the highest level of infra-structural development. Access to electricity, wells, watering points for cattle, and maize mills were all conducive to higher income from this source. These results make sense because infra-structural development needs to be quite extensive for the emergence of appreciable off-farm salaried opportunities.

Some types of community infrastructure seemed to be inimical with one or more income sources. For example, paved roads were negatively correlated with income from resource

extractive activities. But, in general, the estimated coefficients on the road, transport, and distance variables do not say much about the role of road infrastructure in determining the size of the components of rural income. Only one geographic pattern is statistically documented in Appendix Table 1: households further away from the administrative center receive less in remittances.

The fact that the infra-structural variables do not do a good job in explaining the variation in net crop income is another disappointment in Appendix Table 1. Some of the community variables suffer from collinearity with the district dummy variables, but deleting the district dummy variables does not lead to enhanced statistical significance of the infra-structural variables.

The birthplace of the household head gave more transparent results. Rural people not born in the village in which they were residing had significantly better prospects for off-farm, non-agricultural wage and salary earnings. Greater mobility appeared to have translated into greater off-farm income opportunities.

5.10. Risk-related Considerations

Several minor storylines emerge from the source-wise estimates on our seven risk variables. Households with prolonged illness of an adult family member did receive significantly more remittance income than others. Plant pests and diseases were the risk most significantly associated with net crop income in 2001-2002. Both flood risk and plant pest and disease risk were positively correlated with resource extraction activities. This association suggests that farmers participate in resource extraction to cope with income risk. Those households that received emergency seed also benefited more from resource extraction activities than other households. Although not statistically significant, this estimated coefficient suggests that some of these households needed support to cope with income risk if resource extraction activities are viewed as a risk adjustment strategy. Following the same line of thinking, greater drought risk was accompanied by an increased response to participate in the agricultural wage labor market. Higher drought risk was also significantly associated with more livestock sales.

5.11. Livestock Inventories

Owning chickens is highly complementary to crop income. Households with 30 or more chickens have 33% higher crop income than others. Even possession of some chickens translates into marked superiority in crop income. Strong complementarities between chickens and crop income drive the impressive results from one of our simulated experiments, described later in the report, on poverty reduction.

Larger holdings of livestock should be complementary to small-business income and to off-farm wage employment. Cattle require less seasonal effort than crops, and are a logical fit with these off-farm pursuits, which, in turn generate sufficient income to invest in cattle. However, these relationships between cattle ownership and off-farm income sources are not statistically significant. But households that are well endowed in cattle or that own goats are less likely to engage in low-paying activities identified with resource extraction.

5.12. Interactions with Major Sources of Off-farm Income

The link between crop income and small business self-employment was complementary (Appendix Table 1). Another household member who engaged in small business activities was associated with a 6% increase in net crop income. Undertaking off-farm salaried or wage employment was antagonistic to the accrual of both crop and livestock income. Having family members who worked in off-farm wage or salaried employment depressed income from small business self-employment. Conversely, households with family members in business-related self-employment activities were significantly less likely to participate in salaried non-agricultural employment. Having more family members working in wage and salaried occupations was identified with brighter prospects for remittances.

5.13. Agro-ecology and Production Potential

No one agro-ecology topped more than two of the seven income sources in Appendix Table 1. Ceteris paribus, the high altitude north-central region (agro-ecology 10) was characterized by 142% greater net crop income than our reference agro-ecology, the wet central coast (agro-ecology 5). Higher elevation is associated with greater crop choice and easier varietal adaptation for some important species, such as maize, combined with greater population density and proximity to markets in wealthier neighboring countries. These characteristics beget intensification.

The Zambezia Valley and south Tete (agro-ecology 6) scored well on livestock sales and small-business income. As expected, off-farm non-agricultural wage earnings and remittances were higher in the two southern agro ecologies (2 and 3) nearer South Africa. These same agroecologies are characterized by lower agricultural production potential than the others located in central and northern Mozambique so it is also not surprising that resource extraction plays a somewhat greater role in the southern agro-ecologies.

6. INCOME POVERTY

In spite of the fact that income data are seldom used in poverty analysis, we believe that such data can be informative on poverty related issues particularly on explaining the variation across households in the incidence, depth, and severity of income poverty. A comprehensive income survey like the TIA 2002 collects more detailed information on household production than the typical instrument used to gather data on consumption expenditure. This production-related information can be used to explain in greater detail household variation in poverty.

6.1. Incidence of Income Poverty

Documenting household variation in rural poverty is the first step in the analysis. Our income estimates are very low, so low in fact that the vast majority of households appear to fall below any reasonable poverty line. If the bulk of households are poor, there is no variation to analyze. For example, use of the popular global poverty line of one dollar per person per day is clearly too high to generate sufficient variation in the data for subsequent analysis. About 97% of the households fall below the dollar-a-day poverty line.

National poverty lines rise with levels of economic development (Ravallion 1993). 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. We use some recently estimated food poverty lines for six rural regions of Mozambique. These poverty lines were originally estimated from the large consumer expenditure survey analyzed by Datt, et al., 2000. Hence, the consumption baskets index fixed consumption bundles in 1996. Prices for these food poverty lines have been updated based on the recent household expenditure survey in 2002-2003 from the National Statistical Agency (INE) and related analytical work carried out in the Planning and Finance Ministry (MPF 2004). These lines varied from a low of about 5,000 meticais in rural Zambezia and Sofala to a high of about 12,000 meticais in rural Maputo equivalent to a provincial poverty line ranging from about 22 to 55 cents per person per day in US dollars in 2002-2003.

With these “fixed” food poverty lines reflecting the consumption bundles of 1996, the headcount incidence of poverty (for the 4,833 households in our earlier regression analysis) falls to 82% with a 95% conference interval from 80 to 84%. This estimate would be substantially lower if we used purchase prices instead of sales prices of producers from the TIA to value home-produced, on-farm consumption for many households who are net consumers. Most sales took place at or shortly after the harvest; therefore, sales prices are also likely to be seasonally low. Nevertheless, we believe that the use of these food poverty lines provides sufficient variation for analysis particularly for describing the severity of income poverty.

6.2. The Severity of Income Poverty

The head count index is a crude marker of economic welfare. A measure such as the squared poverty gap is preferred because it reflects information on how far the poor are from the poverty line (Ravallion 1993). The poorest household (farthest away from the poverty line) receives a welfare weight that approaches 1. Households with income below but near the poverty line receive a small positive weight. The non-poor are given a weight of zero because their per person per day income exceeds or is equal to the poverty line. Hence, the squared poverty gap is defined along an interval between 0 and 1. Higher values indicate more “severe” poverty.

The frequency distribution of the squared poverty gap is charted in Figure 5 for 25 equally spaced groups between 0 and 1. The mean estimated squared poverty gap is large at 0.35, but the outstanding feature of Figure 7 is the flatness of its empirical distribution. For the poor households, the distribution is uniform with the exception of mild clustering at a few of the lowest income levels. This finding of empirical uniformity suggests that assessment of welfare is not sensitive to the location of the poverty line. Small changes in income, although socially very valuable, will not be reflected in large shifts in the headcount index of income poverty. The flatness of the distribution for the poor households also indicates considerable variation to explain.

Figure 7. The Frequency Distribution of the Severity of Rural Poverty in Mozambique in 2001-2002

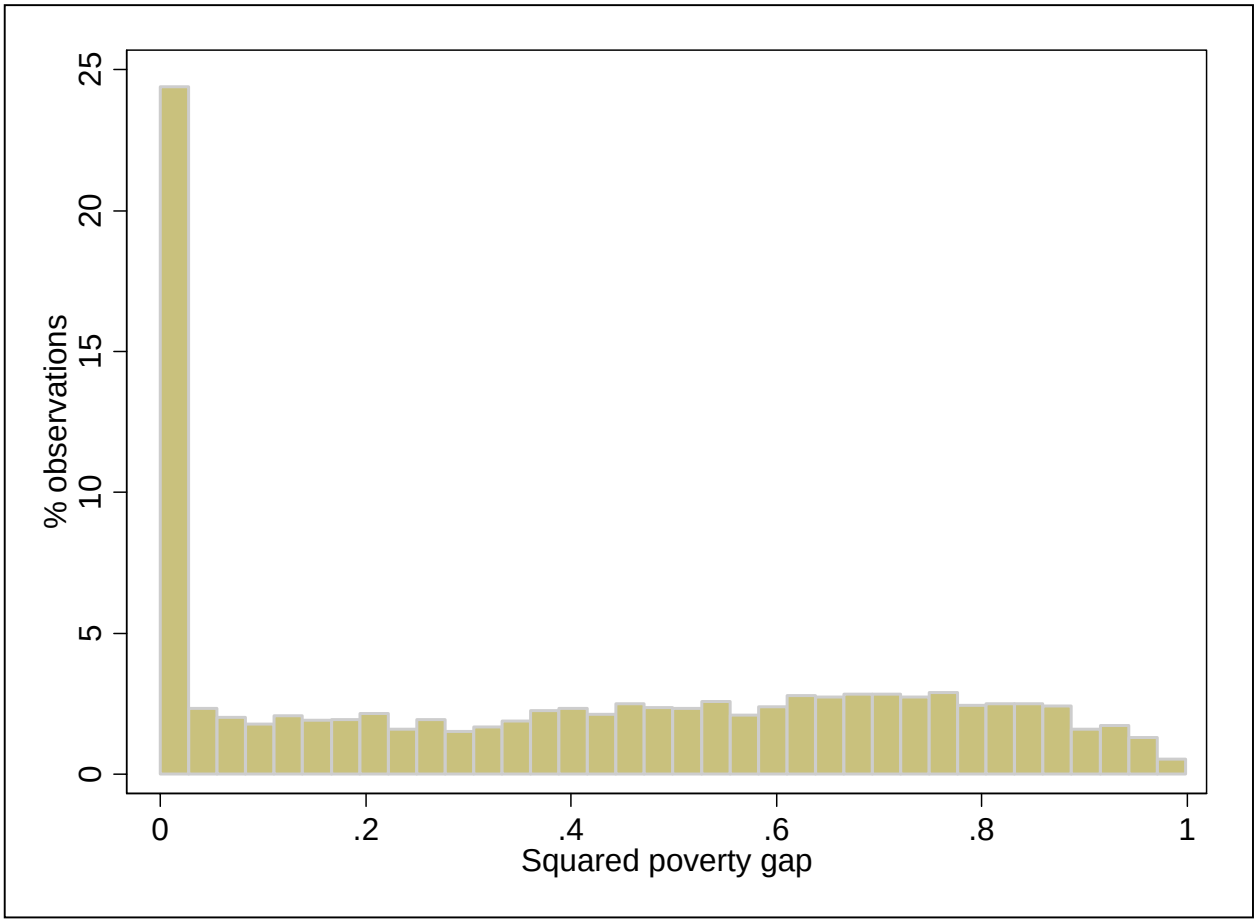


Table 5. Determinants of the Incidence and Severity of Poverty (Logit and Tobit estimates in US$[1])

Independent variable	Estimated coefficient[2]			
	Head count index (Logit)		Squared poverty gap (Tobit)	
	Coeff	t-statistic	Coeff.	t-statistic
Woman-headed household, not a widow	0.123	(0.87)	0.028	(2.35)*
Household headed by a widow	0.116	(0.73)	0.063	(3.59)**
Age of head 30-39	-0.139	(1.06)	-0.010	(0.50)
Age of head 40-49	0.013	(0.09)	-0.006	(0.28)
Age of head 50-59	-0.063	(0.40)	-0.027	(1.23)
Age of head older than 60	-0.289	(1.66)	-0.040	(1.40)
Schooling 1-2 years, base is 0 years	-0.117	(0.89)	0.007	(0.45)
Schooling 3-4 years, base is 0 years	-0.287	(2.46)*	-0.046	(3.38)**
Schooling 5 or more years	-1.085	(8.24)**	-0.119	(5.80)**
Family members aged 0 to 4	0.480	(9.29)**	0.075	(11.86)**
Family members aged 5 to 14	0.360	(10.40)**	0.063	(15.32)**
Male adults aged 15 to 64	0.107	(2.12)*	0.029	(3.80)**
Female adults aged 15 to 64	0.051	(1.10)	0.031	(3.78)**
Family members 65 and older	0.218	(1.99)*	0.054	(3.19)**
Farm size, 0.75-1.745 has.	-0.020	(0.16)	-0.045	(2.83)**
Farm size, 1.75-4.998 has.	-0.437	(3.11)**	-0.091	(4.64)**
Farm size, 5.0 or more has.	-0.925	(4.67)**	-0.179	(4.23)**
Irrigation, one or more fields, (0-1)	-0.382	(3.34)**	-0.077	(4.33)**
Upland fields, base is all lowland fields	-0.009	(0.08)	-0.015	(1.00)
Both upland and lowland fields	-0.107	(0.91)	0.011	(0.011)
Could obtain land, if wanted to (0-1)	-0.148	(1.17)	-0.007	(0.41)
Easy to obtain land in village (0-1)	-0.072	(0.67)	0.002	(0.10)
No fields, base is 1 field	-2.724	(3.17)**	-0.206	(2.06)**
Two fields, base is 1 field	-0.151	(1.27)	-0.032	(1.98)*
Three-four fields, base is 1 field	-0.150	(1.17)	-0.060	(4.60)**
Five or more fields, base is 1 field	-0.030	(0.16)	-0.085	(4.08)**
Land source[3]				
2	-0.680	(2.98)**	-0.083	(1.95)
3	-0.146	(0.79)	-0.020	(0.84)
4	-0.841	(3.59)**	-0.079	(2.09)*
5	-0.359	(2.14)*	-0.060	(2.80)**
6	-0.858	(3.59)**	-0.105	(2.58)**
7	-0.370	(2.12)*	-0.020	(0.77)
8	1.339	(1.69)	0.042	(0.64)
1 to 59 cashew trees (0-1)	0.032	(0.28)	-0.013	(0.89)
60 or more cashew trees (0-1)	-0.150	(0.75)	-0.051	(1.63)
1 to 19 coconut trees, base is 0 trees	-0.139	(0.95)	0.006	(0.32)
20 or more coconut trees, base is 0 trees	-0.685	(3.57)**	-0.111	(4.05)**
One or more fruit trees	0.064	(0.62)	0.005	(0.25)
Own a radio (0-1)	-0.389	(4.04)**	-0.064	(6.00)**
Own a bicycle (0-1)	-0.483	(4.78)**	-0.096	(5.59)**
Own an oil lantern (0-1)	-0.366	(3.87)**	-0.064	(4.09)**
Used animal traction (0-1)	-0.310	(2.38)*	-0.038	(1.42)
Used a tractor, pick-up, or truck (0-1)	-0.449	(2.44)*	-0.185	(3.86)**
Used oil engines or electric pump sets (0-1)	-0.292	(0.88)	-0.102	(1.63)
Cultivated cotton (0-1)	0.069	(0.35)	-0.012	(0.48)
Cultivated tobacco (0-1)	-0.806	(4.16)**	-0.124	(4.66)**

[1]At an exchange rate of US$1 =23,540 meticais.

[2]Absolute value of t statistics in parentheses = * significant at 5%; ** significant at 1%.

[3]Land Sources and Agroecologies are defined in Table 2.

Table 5. Determinants of the Incidence and Severity of Poverty (Logit and Tobit estimates in US$[1]) (cont.)

Independent variable	Estimated coefficient[2]			
	Head count index (Logit)		Squared poverty gap (Tobit)	
	Coeff	t-statistic	Coeff.	t-statistic
Belong to an association (0-1)	-0.104	(0.55)	-0.034	(1.35)
Received information from extension (0-1)	0.114	(0.93)	-0.002	(0.13)
Extension information available in village (0-1)	0.160	(1.65)	0.033	(1.84)
Received information on prices(0-1)	-0.479	(4.90)**	-0.051	(4.08)**
Information on prices available in village (0-1)	0.120	(1.22)	-0.034	(1.64)
Old village before Independence (0-1)	0.197	(2.05)*	0.037	(1.93)**
Houses in village are close together (0-1)	-0.095	(0.98)	-0.027	(1.29)
Born in the village (0-1)	0.139	(1.55)	0.011	(0.88)
Live near a paved road (0-1)	0.041	(0.34)	0.015	(0.70)
Passable road throughout year	-0.099	(0.93)	0.007	(0.35)
Bus transport throughout the year (0-1)	0.105	(0.96)	-0.005	(0.25)
11-20 kms or 1 hour to center	-0.309	(2.49)*	-0.042	(1.66)
21-40 kms or 2-3 hours to center	-0.163	(1.30)	-0.029	(1.14)
More than 40 kms or 3 hours to center	-0.183	(1.47)	-0.062	(2.49)*
Missing information on distance to center	0.139	(0.69)	0.014	(0.49)
Access to electricity in village (0-1)	-0.352	(1.96)	-0.072	(2.16)**
Access to well water in or near village (0-1)	-0.086	(0.88)	-0.008	(0.56)
Access to a market in or near village (0-1)	-0.197	(1.85)	-0.023	(1.27)
Factory in the village (0-1)	-0.460	(1.95)	-0.098	(1.89)**
Input supply store in the village (0-1)	-0.168	(1.35)	-0.039	(2.31)**
Water points for cattle in the village (0-1)	0.043	(0.36)	-0.003	(0.10)
Access to formal credit in the village (0-1)	0.001	(0.01)	0.002	(0.10)
Maize mill in the village (0-1)	-0.182	(1.78)	-0.025	(1.30)
Adult death in past two years	-0.289	(1.48)	0.019	(0.66)
Adult prolonged illness	0.215	(1.21)	0.005	(0.24)
Flood risk (index 0-5)	-0.066	(0.89)	0.015	(0.93)
Drought risk (index 0-5)	0.073	(1.41)	0.009	(1.11)
Plant pest and disease risk (index 0-5)	0.039	(1.21)	0.014	(2.54)*
Animal disease risk (index 0-5)	0.006	(0.23)	-0.003	(0.67)
Received emergency seed (index 0-5)	-0.308	(2.38)*	-0.076	(4.54)**
Crops grown in village: 2-10, base is 1	-0.175	(0.82)	-0.059	(1.70)
Crops grown in village: 11-20, base is 1	-0.441	(1.90)	-0.074	(2.32)**
Crops grown in village: more than 20, base is 1	-0.789	(2.82)**	-0.100	(2.75)**
Underreported self-employment income	0.360	(0.86)	0.045	(0.86)
1-9 head of cattle	-0.445	(2.42)*	-0.025	(0.78)
10 or more head of cattle	-0.831	(4.71)**	-0.115	(3.87)**
1-19 goats (0-1)	-0.076	(0.75)	0.001	(0.05)
20 or more goats (0-1)	0.015	(0.07)	-0.054	(1.12)
1-29 chickens (0-1)	0.035	(0.35)	-0.042	(3.46)**
30 or more chickens (0-1)	-0.354	(1.85)	-0.113	(3.27)**
Agroecology[3]				
2	-0.316	(1.49)	-0.083	(1.67)
3	0.059	(0.25)	-0.052	(1.05)
4	0.184	(0.77)	0.012	(0.24)
6	-0.189	(0.90)	-0.084	(1.47)
7	0.310	(1.47)	0.004	(0.08)
8	0.406	(1.79)	0.021	(0.44)
10	-0.304	(1.26)	-0.128	(2.68)**
Constant	3.023	(6.90)**	0.614	(8.68)**
Observations	4833		4833	

[1]At an exchange rate of US$1 =23,540 meticais.
[2]Absolute value of t statistics in parentheses = * significant at 5%; ** significant at 1%.
[3]Land Sources and Agroecologies are defined in Table 2.

6.3. Explaining the Household Variation in the Incidence and Severity of Income Poverty

The estimated coefficients of the regressions on poverty are presented in Table 5. The head count measure of poverty is estimated directly in a dichotomous-variable logit framework with households falling below the poverty line assigned a one. The variation in the severity of poverty is estimated with a tobit regression with a lower limit 0 and an upper limit 1 circumscribing the interval of the squared poverty gap. The independent variables are the same as those used in the regression on household income with the exception that the district dummy variables are not included. Several of the districts did not have sufficient variation in poverty-related outcomes for successful estimation. Rather than lose the observations from those districts we felt that it would be better to keep all the observations and drop the district variables.

In Table 5, the first column pertains to the logit estimation on the head count index of poverty and the second column contains the tobit estimation on the squared poverty gap. Because poverty is associated with higher positive values in the dependent variable in both estimations, negative signs in Table 5 imply a reduction in poverty and positive estimated coefficients signify an increase in poverty. As expected, many of the variables that explain the variation in household income are also statistically significant (but of opposite sign) in the two poverty equations. In the first column of Table 5, variables that significantly increased the odds of falling below the poverty line included adding a young child or adolescent to the household, owning land ceded by the village chief, and residing in an "old" village.

Many more variables were associated with a significant decrease in the incidence of poverty than with a significant increase (Table 5, first column). More schooling and operated area significantly dampened the incidence of poverty. Large stands of coconut trees were significantly and negatively correlated with the head count index. Receipt of price information was negatively associated with poverty. Ownership of diverse types of productive assets and livestock significantly improved the odds that the household would not fall below the poverty line. With the exception of access to electricity, the community infra-structural variable did not significantly contribute to explaining the household variation in the incidence of poverty. Nor did the sources of risk variables play much of a role. In contrast, households who received emergency seed and those that resided in villages with high production and market potential where more than 20 different crops were cultivated were significantly less likely to be poor than other households.

Given the high estimated incidence of poverty exceeding 80%, the statistically significant variables in the first column of Table 5 do not lead to large movements in the incidence of poverty. Moreover, the confidence intervals in establishing bounds on the estimated probability of poverty are unusually wide.

Estimated coefficients of the squared poverty gap in the second column of Table 5 are considerably more sensitive to small changes in the independent variables than those related to the poverty line which is a blunt measure of human welfare. For example, women-headed households are significantly poorer than male-headed households from the perspective of the squared poverty gap. For widows, the mean predicted squared poverty gap is 0.45 compared to 0.36 to all other households. The difference in these two estimates is greater than the partial estimated coefficient (0.63) in Table 5 because widow-headed households do not score well on other variables associated with severe poverty alleviation.

The importance of household demographic and educational variables in conditioning poverty outcomes is abundantly clear in Table 5. Ceteris paribus, an additional young child leads to a shift upwards in the squared poverty gap index by .075. Achieving five or more years of schooling compared to a background of no schooling is characterized by a sharp decline by .12 in the same index.

Increasing farm size and access to irrigation are also accompanied by significant reductions in the severity of poverty. Similar to the results for the head count index, the ownership of different types of assets plays an important role in dampening severe poverty.

Additionally, more variables occupy small but statistically significant places in explaining the household variation in the squared poverty gap than in the headcount index. Several of the community infra-structural variables, such as electricity and input supply stores, are associated with bootstrapping rural households out of severe poverty. Communities more prone to plant and disease risk are characterized by more severe poverty. Ownership of chickens does not tell us much about who is above or below the rural poverty line but numbers of chickens are very informative about the severity of poverty. The high altitude agro-ecology 10 is the region most protected from severe income poverty. Shifting from agro-ecology 5 to agro-ecology 10 is accompanied by a .13 reduction in the squared poverty gap index equivalent to moving from a predicted value of 0.42 for the wet SAT Central Coast to 0.29 for the wet SAT high altitude North Central interior.

Overall, the tobit equation on the severity of poverty performs well. The majority of the estimated coefficients have signs consistent with expectations listed in Table 2, and more variables are statistically significant than in the log linear regressions in Table 4.

6.4. Scenarios for Reducing Rural Income Poverty

Based on the estimates in Table 5, we can "simulate" some medium-term scenarios that potentially alleviate poverty. We follow the general approach used by Datt and Joliffe (1998) for Egypt and Datt et al. (2000) for Mozambique, but our (conventional) direct method is not as efficient as their indirect procedures (see Datt et al. 1998). In both of those studies, the authors found that improving educational attainment had a large impact on reducing consumption poverty. In general, the simulated agricultural scenarios did not result in sizable declines in consumption poverty.

Before discussing the results, the simulation methodology warrants several comments. First, the predicted estimates are generated from the reduced form estimates reported in Table 5. No attempt is made to structurally model income generation and carry out a "formal" simulation exercise. Secondly, only variables with statistically significant coefficients in Table 5 were selected as candidates for the scenarios. Thirdly, these results are merely illustrative and only indicate rough orders of magnitude. The results of the simulation are sensitive to how the model was specified. Fourthly, the scenario needs to pass some minimal standard of technical and economic plausibility.[8] The scenarios are described in Table 6 together with the estimated

[8] An example of an implausible scenario would be the 100% adoption of tractor use. Undoubtedly, this mechanized scenario would show a large reduction in poverty because few rural households now use tractors so the scenario would affect the vast majority and the tractor use coefficient is large (in absolute value) in Table 5. But history tells us that "forced" tractor-promotion schemes are non-starters in Sub-Saharan Africa where population density and access to markets are the main determinants of agricultural intensification (Binswanger and Donovan 1987).

results for the severity of income poverty in the form of the % change in the squared poverty gap index that is theoretically the more appealing and, usually, more sensitive to change than either the head count or poverty gap measures. Of the 13 scenarios in Table 6, the first two pertain to education and the last two on widow-headed households and family size provide an order of magnitude reference for the nine agricultural scenarios.

The feasibility and cost of the agricultural scenarios vary substantially. Perhaps the agricultural scenario that is least feasible is number 4: moving very smallholders into the next farm-size group. Nonetheless, the estimated results are of interest to see whether or not this scenario is accompanied by an appreciable impact on poverty.

The base simulation with the independent variables set at their present levels generates a predicted level for the squared poverty index of about 35, reflecting a high level of income poverty. This level is significantly higher than what is commonly predicted for consumption poverty (Datt and Joliffe 1997; Datt et al. 2000). For that reason, the impact of the scenarios on income poverty ranging from about 1 to 15% in Table 6 are substantially smaller than changes

Table 6. Changes in the Severity of Rural Income Poverty by Scenario

Scenario No.	Description		Change in the squared poverty gap index (in %)
	General	Specific	
1	Education	Shift upwards in one educational category, i.e., illiteracy to 1-2 years, 1-2 years to 3-4 years, and 3-4 years to 5 or more years	-7.0
2	Education	All household heads with some schooling attain highest educational level of 5 or more years	-9.3
3	Farm size	Households in the next to largest farm size category move to the largest category	-7.0
4	Farm size	Households in the smallest farm size category (0 – 0.75 ha) move to the next group (0.75 – 1.75 ha)	-2.5
5	Fields	Similar to Scenario 1, households move up to the next field number category	-6.5
6	Farm size + fields	Scenario 3 plus all households in farm size 4 (>5 ha) operate 5 or more fields	-13.8
7	Local crop potential	Similar to Scenario 1, increase the number of crops that are cultivated in the community by one category	-9.3
8	Intensification: coconuts	Households with 1-19 coconut trees move to the next level of 20 or more	-3.1
9	Intensification: cattle	Households with 1-9 head move to the next level of 10 or more	-1.1
10	Intensification: chickens	Households with 1-29 chickens move to the next level of 30 or more	-11.5
11	Intensification: tobacco	Tobacco cultivation reaches full adoption in the 8 districts where tobacco is most widely cultivated	-2.4
12	Other	Incidence of widow-headed households is halved; i.e., 50% of widow-headed households are changed to male-headed households	-1.0
13	Other	One more young child (ages 0-4) to households with one or more children in the 0-4 and 5-14 age groups	+16.7

of 25 to 40% commonly reported for consumption poverty. Therefore, even a small reduction in income poverty should be associated with a relatively large gain in economic welfare. For example, an improved maize variety that is adopted by all maize-cultivating households and results in a 10% increase in yield is equivalent to a reduction in the severity of poverty of 1.5%. An equivalent variety for cassava is associated with a 1.4% reduction in the squared poverty gap index. Although these results were calculated independently of the regression estimates in Table 5, they provide a perspective on the meaning of the magnitude of different changes in the severity of poverty.

The non-agricultural scenarios 12 and 13 also furnish some perspective. Adding another young child to the family is accompanied by a 17% increase in poverty. This result is driven by a relatively large coefficient on the young child age group and by the fact that many households have at least one child and are affected by the scenario. In contrast, halving the incidence of widow-headed households does not make a large dent in income poverty (-1.0%) because widow-headed households comprise only 10% of the household population and because the estimated coefficient for widows is relatively small in Table 5. Widow-headed households are characterized by smaller family size than other households and poverty indices are calculated on a per capita basis that dampens income poverty in smaller households.

Several of the agricultural scenarios compete favorably with the education scenarios. In particular, the farm-size growth and diversification scenario (no. 6) is associated with a 14% reduction in poverty. At this stage in Mozambique's development, policies and investments that promote more differentiation of the agricultural sector resulting in more medium-sized farms can lead to favorable poverty consequences. Opening up more cropping opportunities (scenario 7) through market and infra-structural improvement is also associated with substantial scope for poverty reduction.

The agricultural scenario with the smallest impact centers on the intensification of cattle production (no. 9, -1.1%). The large size of the estimated coefficient on the largest cattle-owning group in Table 5 does not compensate for the observation that only a very small minority of households owns a few head of cattle (Table 3c).

The large poverty-reducing impact of intensifying chicken production is the most surprising result in Table 6; however, this result is easy to explain. About 2/3rds of the farm households are involved in this scenario, and the coefficient on households with 30 or more chickens is one of the largest in Table 5. This result is not about having 30 or chickens per se, but it is about behaving in the same manner with households that now have 30 or more chickens. Maintaining a flock of 30 or more chickens takes considerable effort in rural Mozambique. Newcastle disease is endemic, and chickens are often used to smooth seasonal consumption to buy maize during the hunger season.

7. PERCEPTION ON THE CHANGE IN ECONOMIC CONDITION OVER TIME

An analysis comparing the results of the TIA 1996 to those for the TIA 2002 is currently being carried out. We can also look in a small way at economic progress over time with retrospective information from the TIA 2002 which asked: Has your economic situation improved, stayed the same, or deteriorated compared to three years ago?

The responses are tabulated in Table 7 together with the estimates of income for each category. The data show a high degree of congruence between the perception of change in welfare over time and the mean level of household income. Those who felt that their situation had worsened had mean household income estimated at $217; a comparable estimate for those who voted for improvement was $392. More households perceived a deterioration in living standards, perhaps attributed to recent natural disasters, particularly flooding in 2000, but a sizable number (1,564) said that they were materially better off.

What are the determinants of these responses? What are the characteristics of households who said that their economic situation had improved or stayed the same vis-à-vis those who perceived that their economic condition had worsened? To reply systematically to these questions we analyze the three differing responses in the statistical framework of an ordered probit: 3=worsening, 2=stayed the same, and 1=improved. The independent variables are the same regressors we used to examine the determinants of household income, its component sources, and poverty. Positive estimated coefficients show a greater tendency to select the worsening outcome. Negative estimated coefficients indicate that households were more likely to state that their situation had improved.

Many of the estimated determinants in Table 8 on the perception of change in economic condition reinforce our earlier findings on explanations for household variation in income and poverty. But there are also several interesting surprises. As expected, female-headed households were significantly less likely to say that their condition had improved or even stayed the same. Households with young children were also less likely to say that their lives had improved materially. In contrast, households with three or more years of education were significantly more likely to respond that their economic condition had become better.

Table 7. Perception of the Change in Economic Condition by Household Income

Perception	Mean income	Std. Error	95% confidence interval		No. of observations
Improved	392	32	330	455	1564
Stayed the same	284	19	247	322	1367
Worsened	217	14	190	245	1968
No response	90	21	48	132	9

Table 8. Determinants of the Perception of Change in Economic Condition[1] (ordered Probit estimates)

Independent variable	Estimated Coefficients[2]	
	Coefficient	t-statistic
Woman-headed household, not a widow	0.157	(2.96)**
Household headed by a widow	0.279	(4.37)**
Age of head 30-39	0.062	(1.16)
Age of head 40-49	0.131	(2.33)*
Age of head 50-59	0.135	(2.16)*
Age of head older than 60	0.244	(3.39)**
Schooling 1-2 years, base is 0 years	-0.030	(0.59)
Schooling 3-4 years, base is 0 years	-0.130	(2.79)**
Schooling 5 or more years	-0.137	(2.37)*
Family members aged 0 to 4	0.047	(2.71)**
Family members aged 5 to 14	0.008	(0.61)
Male adults aged 15 to 64	0.001	(0.03)
Female adults aged 15 to 64	0.001	(0.05)
Family members 65 and older	0.014	(0.30)
Farm size, 0.75-1.745 has.	-0.094	(1.93)
Farm size, 1.75-4.998 has.	-0.085	(1.51)
Farm size, 5.0 or more has.	-0.005	(0.05)
Irrigation, one or more fields, (0-1)	-0.016	(0.33)
Upland fields, base is all lowland fields	-0.008	(0.17)
Both upland and lowland fields	0.014	(0.29)
Could obtain land, if wanted to (0-1)	-0.063	(1.21)
Easy to obtain land in village (0-1)	-0.137	(3.16)**
No fields, base is 1 field	-0.431	(1.62)
Two fields, base is 1 field	0.001	(0.01)
Three-four fields, base is 1 field	-0.012	(0.23)
Five or more fields, base is 1 field	-0.115	(1.46)
Land source[3]		
2	-0.101	(1.01)
3	-0.090	(1.28)
4	0.071	(0.72)
5	-0.083	(1.29)
6	-0.137	(1.27)
7	0.009	(0.13)
8	0.194	(0.93)
1 to 59 cashew trees (0-1)	0.087	(1.94)
60 or more cashew trees (0-1)	0.239	(2.70)**
1 to 19 coconut trees, base is 0 trees	-0.063	(1.01)
20 or more coconut trees, base is 0 trees	-0.025	(0.28)
One or more fruit trees	-0.047	(1.15)
Own a radio (0-1)	-0.206	(5.36)**
Own a bicycle (0-1)	-0.137	(3.17)**
Own an oil lantern (0-1)	-0.083	(2.18)*
Used animal traction (0-1)	-0.043	(0.73)
Used a tractor, pick-up, or truck (0-1)	-0.220	(2.52)*
Used oil engines or electric pump sets (0-1)	0.168	(1.07)
Cultivated cotton (0-1)	-0.019	(0.25)
Cultivated tobacco (0-1)	-0.199	(2.20)*

[1]Improved = 1; stayed the same = 2; and worsened = 3.
[2]Absolute value of t statistics in parentheses = * significant at 5%; ** significant at 1%.
[3]Land sources and agroecologies are defined in Table 2.

Table 8. Determinants of the Perception of Change in Economic Condition[1] (ordered Probit estimates) (cont.)

Independent variable	Estimated Coefficients[2]	
	Coefficient	t-statistic
Belong to an association (0-1)	-0.031	(0.38)
Received information from extension (0-1)	0.052	(1.03)
Extension information available in village (0-1)	0.001	(0.02)
Received information on prices (0-1)	-0.083	(2.04)*
Information on prices available in village (0-1)	-0.025	(0.63)
Old village before Independence (0-1)	0.045	(1.14)
Houses in village are close together (0-1)	-0.028	(0.73)
Born in the village (0-1)	0.040	(1.09)
Live near a paved road (0-1)	-0.014	(0.28)
Passable road throughout year	-0.017	(0.40)
Bus transport throughout the year (0-1)	0.034	(0.75)
11-20 kms or 1 hour to Center	-0.095	(1.83)
21-40 kms or 2-3 hours to Center	-0.052	(1.01)
More than 40 kms or 3 hours to Center	-0.061	(1.23)
Missing information on distance to Center	-0.037	(0.46)
Access to electricity in village (0-1)	-0.093	(1.18)
Access to well water in or near village (0-1)	-0.028	(0.72)
Access to a market in or near village (0-1)	-0.080	(1.83)
Factory in the village (0-1)	-0.291	(2.69)**
Input supply store in the village (0-1)	-0.081	(1.57)
Water points for cattle in the village (0-1)	0.019	(0.37)
Access to formal credit in the village (0-1)	-0.106	(1.82)
Maize mill in the village (0-1)	-0.052	(1.25)
Adult death in past two years	0.254	(2.97)**
Adult prolonged illness	0.152	(2.23)*
Flood risk (index 0-5)	0.089	(2.98)**
Drought risk (index 0-5)	0.068	(3.36)**
Plant pest and disease risk (index 0-5)	0.014	(1.11)
Animal disease risk (index 0-5)	-0.012	(1.05)
Received emergency seed (index 0-5)	-0.080	(1.45)
Crops grown in village: 2-10, base is 1	-0.149	(1.72)
Crops grown in village: 11-20, base is 1	-0.239	(2.56)*
Crops grown in village: more than 20, base is 1	-0.073	(0.64)
Underreported self-employment income	0.021	(0.14)
1-9 head of cattle	-0.057	(0.67)
10 or more head of cattle	-0.285	(3.49)**
1-19 goats (0-1)	-0.067	(1.61)
20 or more goats (0-1)	-0.167	(1.71)
1-29 chickens (0-1)	-0.086	(2.13)*
30 or more chickens (0-1)	-0.356	(4.21)**
Agroecology[3]		
2	0.100	(1.15)
3	0.595	(6.30)**
4	-0.221	(2.42)*
6	-0.151	(1.85)
7	-0.056	(0.69)
8	0.086	(0.99)
10	-0.479	(4.90)**
Observations	4833	
Log likelihood	-4860	

[1]Improved = 1; stayed the same = 2; and worsened = 3.
[2]Absolute value of t statistics in parentheses = * significant at 5%; ** significant at 1%.
[3]Land sources and agroecologies are defined in Table 2.

The land-related variables present an interesting mosaic. Surprisingly, households in the largest farm-size group had lower improvement ratings than the next to the smallest group. On the other hand, households residing in land-abundant communities were more likely to perceive an improvement between 1999 and 2001. Owners of cashew trees tended to say that they were materially worse off.

Some events are revealed to have a much stronger impact on perceived well-being than on income. Households suffering an adult death or a prolonged illness, for example, were significantly less likely to register an affirmative response. Indeed, both of these variables have statistically significant and positive estimated coefficients indicating that affected households were significantly more likely to say that they were worse off. Households in communities with recent floods and droughts were significantly less likely to say that economic matters had gotten better for their family. Agroecology 3 representing the interior of the south region is the place where a positive response was least likely. The frequent occurrence of droughts and floods in that region probably underlies that response.

Characteristics favoring a positive perception underscore several of our earlier findings and include the following: receipt of price information, use of a tractor, the cultivation of tobacco but not cotton, ownership of a radio, bike, and oil lantern, ownership of livestock, a sizable flock of chickens, and existence of community infrastructure (especially a factory). Lastly, households in the high altitude agro-ecology 10 were more likely to feel that they had prospered in the recent past.

8. CONCLUSIONS AND POLICY IMPLICATIONS

The previous four sections on the determinants of rural household income, sources of income, income poverty, and perceived change in economic well-being have generated many findings that are summarized in this concluding section. We start with the "good news" findings that suggest a healthy and dynamic agricultural sector that is, in turn, contributing to the growth of rural income. Cultivating tobacco was one variable that impacted positively on all three measures of rural welfare that we analyzed. Growing tobacco was significantly associated with an increase in household income, a reduction in income poverty, and an improvement in the perception of economic condition. Other variables that gave similarly optimistic results on all counts included schooling (three or more years for the household head), receipt of price information, decreased risk of drought and plant disease, and ownership of bikes, radios, and chickens. Although the latter assets are in part a consequence of the growth in rural income, their positive relationship not only to income level and perceived well-being but also to poverty reduction speaks to the importance of accumulating relatively small and divisible assets at this stage of Mozambique's economic development.

The high altitude north-central agro-ecology also stood out as a dynamic region for rural income level, poverty reduction, and perceived improvement in economic condition. Rural income in this interior region was stimulated by both input and output markets in neighboring countries and by favorable conditions, such as access to animal traction.

Positive interactions among income sources can reinforce and multiply growth in the agricultural sector. We documented a significant interaction between agricultural crop income and off-farm small business income. Households with more members working in own-self employment off the farm were characterized by increased net crop income. These households figured more prominently than others in renting (i.e., borrowing) and buying land for subsequent investment in agriculture.

Absence of evidence on "supposed" constraints also provides grounds for optimism. For example, we found that land ownership via government intervention and purchases and sales in the formal market was not the only means to ownership that was significantly associated with reduced poverty. Moreover, how land was obtained did not materially influence the perception of change in economic condition. Farm size was not associated with off-farm sources of income that could have resulted in increased relative inequality.

Although it may seem self-evident, our results also show that the agricultural sector is capable of playing a large role in determining rural welfare. Several of our agricultural scenarios in Table 6 compete favorably with the education simulations that usually dwarf the predicted contributions of the agricultural scenarios in an exercise such as this one.

We also uncovered several causes of concern for the agricultural sector. Income poverty is widespread, deep, and severe in rural Mozambique. Use of improved inputs is negligible. The contribution of livestock to rural income is very low. It does not take multivariate statistical analysis to reveal these empirical facts, but our analysis does help to flesh out several dimensions of the problem of low rural incomes.

One of the main sources of concern is the lack of evidence on returns to schooling in agriculture. Datt et al. (2000) also documented a significant negative interaction between female literacy and employment in the agricultural sector. Our empirical evidence suggests that returns to schooling are not reflected in crop and livestock income. However, returns to

schooling are statistically significant in two of the most important off-farm income sources: (1) off-farm self-employment and (2) off-farm non-agricultural wage earnings. Households who received information from extension agents had somewhat higher (5% with borderline statistical significance) net crop income than other households, but they did not excel in any other aspect of rural income. It appears that Mozambique has now reached a stage of economic development where growth in agriculture is constrained by the paucity of locally adapted research findings. Relying on off-farm income sources to grow the small-farm commercial sector may be a viable option in southern Mozambique where crop potential is limited and demand for labor from South Africa is a reality, but it is not a sustainable proposition in northern and central Mozambique where off-farm income hinges on growth in agriculture.

A collateral source of concern pertains to the lack of differentiation in the smallholder sector. Only 3-4% of households operate farms exceeding 5 hectares. Even on the larger farms cultivated area is small and commodity production, although diversified, rarely exceeds five tons per household for all crops. The transition from subsistence to semi-subsistence to commercial agriculture normally takes several generations, but in Mozambique the public sector should be sufficiently proactive to ensure that the transition is more rapid. An increasingly commercial smallholder sector will be accompanied by sizable reductions in income poverty. We showed that graduating the medium-farm size group of (1.75-5.0 ha) to the largest group of more than 5 hectares generated about 3-4 times more poverty-reduction impact than shifting the smallest land-owning group (less than 0.75 ha) to the next level (0.75-1.75 ha). With so much income poverty and so little differentiation in the agricultural sector, a potential negative trade-off between growth and relative inequality is not a cause for concern at this stage in Mozambique's rural development.

Low returns for cultivating more land appear to be the principal constraint to expansion of the smallholder commercial sector. Evidence for the low returns hypothesis crops up at several points in the paper. The pure income advantage of the largest land-operating group, representing less than 5% of the rural population, is only 45% of the smallest land-holding group, representing 20% of the population. Likewise, the partial income gain between the largest and next largest farm-size category was only 10%. Farm households operating more than 5 hectares did not feel that their economic situation had improved in the past three years. Indeed, households in the two middle size groups were more likely to say that their economic condition had improved compared to either the largest or smallest group. About 15 variables were statistically linked to perceived improvement in Table 8, but large farm-size was not one of them.

The results also highlight several sub-sector sources of concern. Sizable holdings of cashew trees (60 or more) only generated a 12% net gain in household income. Although the coconut sub-sector could not be called healthy with a major infestation of lethal yellowing disease on the coast, more specialized coconut producers were characterized by a 24% increase in household income with only one-third as many trees as cashew producers. More specialized cashew producers also felt that their economic situation had deteriorated in the recent past.

The performance of cotton in generating rural income also did not measure up to expectations. Cotton did not contribute significantly to increased income or to reduced poverty in 2001-02. Low prices and low productivity are the main explanations for cotton's meager contribution to rural welfare.

A last source of concern centers on the inferior income position of women-headed households in general and widows in particular. Similar to the results of Datt et al. (2000) on consumption

expenditure, we found that women-headed households were significantly disadvantaged in rural income. Additionally, we found that households headed by widows were considerably worse off than other female-headed households. This finding points to the potential value of differentiating between widow and non-widows in programs targeted towards women farmers who are household heads. The inferior income position of widows relative to all other households was attributed to very low values for crop and livestock income. Expanding opportunities to earn income from the latter income source is a clear priority in Mozambique where livestock contributes only 3% to household income. Women-headed households, particularly widows, should not be bypassed in program development or should receive targeted assistance in livestock-rearing activities that are oriented to their shared circumstances.

Our study has also generated some methods implications for the measurement of rural income in surveys ranging from rapid rural appraisal to future TIAs that are nationally representative with lengthy questionnaires. We identified several significant and easy to measure proxy variables for income that should be included in any rapid income survey. Occupational status of family members is one. Number of fields is another, and number of chickens also qualifies as an important marker of rural household income. The predictive work of Tschirley, Rose, and Marrule (2000) can also be updated with these new estimates for use by NGOs and other groups who are interested in assessing impact of development projects.

Turning to questionnaire design of the next national rural income survey, a question on the change in economic condition should be retained as it gave insightful results. Of course, it would be even better to include a large number of the TIA 2002 households in the next round so that a panel can be established to assess changes on the same households over time.

Several areas for questioning need to be rethought. Information on distance and road transport did not result in any statistical significance in our analysis. It is hard to believe that these variables are not important in determining rural income in Mozambique, but we were unsuccessful in capturing any significant effects. Perhaps more objective measurement based on the satellite coordinates of interviewed communities overlaid with a road grid in a GIS format is needed to illuminate the consequences of improvements in road transport and related market development in Mozambique.

To finalize this report we highlight the key policy implications that flow from our analysis. While there is clear evidence of a rural economy dynamic in tobacco-growing areas and the north-central agro-ecology, the agricultural sector as a whole is under-performing relative to its potential contribution to poverty reduction. There is an over-arching need to improve the profitability of Mozambican agriculture through investments in technology that raise productivity, and reductions in the cost of input and output market access. Specific measures to be taken include:

1) Promote the emergence of commercial smallholder group of farmers through access to improved technologies and related services (input and output markets, extension and market information, financial services, land titling);

2) Expand smallholder access to low-cost methods of irrigation and/or conservation farming techniques to reduce risk (in contrast to the recent emphasis of heavy investment in formal perimeter irrigation schemes);

3) Promote a diversified range of crop production and market opportunities available to smallholders;

4) Enable a higher proportion of rural households to maintain a viable poultry enterprise;

5) Develop and implement a more integrative approach to gender programs that ensures widows are not bypassed by agricultural development programs, and that educates men and women on family spacing and HIV/AIDS prevention;

6) Urgently review current cashew and cotton policies and strategies that affect the welfare of a large number of rural households; and

7) Further improve the effectiveness of the TIA survey as an instrument to monitor the contribution of the agricultural sector to poverty reduction by adopting a panel sample (repeat visits to the same households over time) and collecting additional information on agricultural technology and market access.

APPENDIX

Appendix Table 1. Determinants of Sources of Income[1] (OLS and Tobit estimates)							
			Self-employment		Off-farm wage earnings		
Independent variable	**Net crop income[3]**	**Livestock sales**	**Small business**	**Resource extract.**	**Non-agricultural**	**Agricultural**	**Remittances**
Woman-head, not a widow	0.006[4]	-16.481	-85.066	-122.200	-442.376	-57.258	83.345
	(0.17)	(1.33)	(0.91)	(3.19)**	(1.61)	(1.84)	(3.06)**
Household headed by a widow	-0.162	-29.705	-183.110	-171.313	-975.207	-42.184	83.789
	(3.33)**	(1.75)*	(1.81)	(4.99)**	(2.53)**	(1.71)	(3.33)**
Age of head 30-39	0.015	16.037	-189.356	-80.000	36.920	-21.888	-74.494
	(0.46)	(1.67)	(1.97)	(2.46)**	(0.20)	(0.88)	(3.10)**
Age of head 40-49	0.019	-2.891	-224.357	-87.487	-65.555	-60.126	-2.848
	(0.49)	(0.28)	(2.83)**	(2.99)**	(0.31)	(2.10)*	(0.10)
Age of head 50-59	0.051	-7.336	-517.215	-147.584	-116.904	-57.857	45.955
	(1.14)	(0.69)	(3.18)**	(3.96)**	(0.82)	(1.59)**	(1.39)**
Age of head older than 60	0.046	-0.011	-512.466	-90.259	-604.370	-92.773	112.279
	(0.85)	(0.00)	(3.77)**	(1.98)*	(1.74)	(2.33)*	(2.33)*
Schooling 1-2 years, base is 0 years	-0.034	9.698	-18.863	40.540	136.099	-32.648	25.340
	(0.92)	(0.06)	(0.23)	(1.20)	(0.88)	(1.55)	(1.15)
Schooling 3-4 years, base is 0 years	0.041	-13.410	120.674	-1.427	312.215	-42.595	37.712
	(1.34)	(1.24)	(1.57)	(0.08)	(1.95)	(1.50)	(1.70)
Schooling 5 or more years	-0.024	-3.121	271.467	-107.156	1,004.836	-70.076	75.273
	(0.73)	(0.029)	(2.19)*	(3.23)**	(4.15)**	(1.97)*	(2.82)**
Family members aged 0 to 4[2]	-0.013	-4.580	-34.474	-0.527	-86.353	8.862	-0.890
	(0.98)	(1.21)	(1.02)	(0.05)	(1.56)	(0.82)	(0.12)
Family members aged 5 to 14[2]	0.017	4.243	-16.562	10.088	80.393	3.363	2.413
	(1.59)	(1.74)	(0.78)	(1.20)	(1.68)	(0.40)	(0.42)
Male adults aged 15 to 64[2]	0.047	16.178	212.484	49.883	145.799	36.673	-21.988
	(2.18)*	(2.84)**	(2.06)*	(4.03)**	(1.74)	(2.44)*	(1.59)
Female adults aged 15 to 64[2]	0.037	11.490	130.514	-14.568	250.218	11.995	-4.561
	(2.11)*	(2.08)*	(3.14)**	(0.75)	(3.51)**	(1.10)	(0.46)
Family members 65 and older[2]	0.047	25.490	86.059	-29.879	-53.035	-29.276	4.621
	(1.18)	(2.19)*	(0.77)	(1.14)	(0.30)	(1.13)	(0.18)

[1]In US$, at an exchange rate of US$1 = 23,540 meticais.
[2]Continuous variables; all others are dummy variables 0-1.
[3]ln income.
[4]Absolute value of t statistics in parentheses = * significant at 5%; ** significant at 1%.
[5]Land Sources and Agroecologies are defined in Table 2.

Appendix Table 1. (cont.)

			Self-employment		Off-farm wage earnings		
Independent variable	**Net crop income[3]**	**Livestock sales**	**Small business**	**Resource extract.**	**Non-agricultural**	**Agricultural**	**Remittances**
Farm size, 0.75-1.745 has.	0.327	24.283	40.648	-14.651	-76.228	-52.097	-6.903
	(8.63)**	(2.09)*	(0.48)	(0.62)	(0.47)	(2.32)*	(0.35)
Farm size, 1.75-4.998 has.	0.576	23.466	23.170	-5.769	-18.867	-50.305	-11.797
	(11.34)**	(1.85)	(0.19)	(0.16)	(0.10)	(1.41)	(0.44)
Farm size, 5.0 or more has.	0.875	20.392	-39.257	-3.181	-238.463	-75.591	-28.450
	(8.63)**	(1.02)	(0.16)	(0.05)	(0.65)	(1.08)	(0.58)
Irrigation, one or more fields	0.217	9.024	72.540	13.408	212.214	-26.381	0.678
	(6.88)**	(0.93)	(0.98)	(0.72)	(1.43)	(0.84)	(0.03)
Upland fields only	0.018	-1.371	24.971	2.446	-323.634	30.552	-17.296
	(0.56)	(0.15)	(0.26)	(0.10)	(2.17)*	(1.08)	(0.87)
Both upland and lowland fields	-0.070	1.483	-2.399	-48.781	-242.426	29.425	-12.169
	(2.07)*	(0.19)	(0.03)	(2.20)*	(1.52)	(0.97)	(0.59)
Could obtain land, if wanted to	0.028	4.120	77.282	14.454	183.075	-4.348	47.024
	(0.66)	(0.35)	(0.74)	(0.48)	(1.10)	(0.16)	(2.45)*
Easy to obtain land in village	0.084	27.848	-132.705	9.647	-2.516	-60.982	-26.328
	(2.53)*	(2.29)*	(1.48)	(0.44)	(0.02)	(2.51)*	(1.21)
No fields, base is 1 field	-1.346	57.501	1,884.093	-43.509	272.668	3.248	-87.206
	(4.91)**	(0.98)	(1.62)	(0.36)	(0.50)	(0.03)	(0.78)
Two fields, base is 1 field	0.247	9.472	62.569	37.586	-236.173	48.881	33.767
	(5.56)**	(1.01)	(0.86)	(1.63)	(1.39)	(1.81)	(1.39)
Three-four fields, base is 1 field	0.342	43.585	166.845	42.473	-52.173	68.330	20.994
	(6.55)**	(2.42)*	(1.51)	(1.66)	(0.28)	(2.24)*	(0.95)
Five or more fields, base is 1 field	0.471	50.355	121.782	44.456	-348.352	125.278	42.460
	(7.28)**	(2.07)*	(0.94)	(1.09)	(1.26)	(2.57)*	(1.03)

Appendix Table 1. (cont.)

			Self-employment		Off-farm wage earnings		
Independent variable	**Net crop income[3]**	**Livestock sales**	**Small business**	**Resource extract.**	**Non-agricultural**	**Agricultural**	**Remittances**
Landsource[5]							
2	0.156	-34.161	31.251	-48.430	584.406	50.963	64.623
	(2.49)*	(1.46)	(0.18)	(0.61)	(1.90)	(0.66)	(1.06)
3	0.075	-14.314	278.084	4.526	43.743	-25.345	-1.526
	(1.32)	(1.06)	(2.14)*	(0.13)	(0.21)	(0.60)	(0.04)
4	-0.055	-12.772	571.904	-41.471	267.614	49.938	-1.812
	(0.58)	(0.65)	(3.37)**	(0.88)	(1.09)	(1.13)	(0.03)
5	0.059	5.715	287.054	9.930	103.083	-42.741	27.538
	(1.00)	(0.56)	(2.26)*	(0.27)	(0.50)	(1.06)	(0.71)
6	0.034	20.501	771.824	-58.547	293.777	6.816	141.196
	(0.46)	(0.94)	(2.63)**	(0.68)	(0.93)	(0.11)	(1.97)
7	0.018	-33.473	283.050	-27.550	-84.717	-41.254	8.564
	(0.28)	(2.00)*	(2.36)*	(0.69)	(0.37)	(1.18)	(0.20)
8	-0.286	-16.671	14.669	15.350	475.226	104.100	9.196
	(2.03)*	(0.39)	(0.04)	(0.18)	(1.02)	(1.07)	(0.11)
1 to 59 cashew trees	0.079	-12.049	-39.062	-7.215	0.498	0.348	11.562
	(2.01)*	(1.33)	(0.61)	(0.32)	(0.00)	(0.01)	(0.52)
60 or more cashew trees	0.179	10.143	-189.884	-60.551	401.732	69.634	131.077
	(2.70)**	(0.63)	(1.75)	(1.10)	(1.94)	(1.00)	(2.41)*
1 to 19 coconut trees	0.032	4.719	328.829	32.933	-137.492	-42.912	33.268
	(0.77)	(0.35)	(3.23)**	(1.16)	(0.63)	(1.51)	(1.08)
20 or more coconut trees	0.395	8.129	159.330	19.162	-33.430	-35.216	-42.854
	(3.88)**	(0.36)	(1.50)	(0.41)	(0.13)	(0.67)	(1.40)
One or more fruit trees	0.108	17.284	70.842	-35.448	-145.448	-25.547	13.231
	(2.92)**	(1.54)	(1.12)	(2.00)*	(0.91)	(1.23)	(0.61)
Own a radio	0.068	23.602	112.437	4.262	266.922	-14.532	38.275
	(2.69)**	(2.63)**	(1.60)	(0.24)	(2.35)*	(0.69)	(1.67)
Own a bicycle	0.143	18.897	329.479	22.913	2.537	-25.079	44.671
	(3.45)**	(1.91)	(2.73)**	(0.82)	(0.02)	(0.98)	(1.65)
Own an oil lantern	0.107	-0.754	111.054	-31.107	228.403	-18.052	8.529
	(3.31)**	(0.09)	(1.65)	(1.20)	(1.45)	(0.76)	(0.46)

Appendix Table 1. (cont.)

			Self-employment		Off-farm wage earnings		
Independent variable	**Net crop income[3]**	**Livestock sales**	**Small business**	**Resource extract.**	**Non-agricultural**	**Agricultural**	**Remittances**
Used animal traction	0.088	38.706	78.170	-31.481	-54.368	67.455	51.840
	(1.56)	(2.06)*	(0.69)	(0.64)	(0.26)	(1.75)	(2.75)**
Used a tractor, pick-up, or truck	0.439	47.272	1,173.640	-18.154	526.356	-36.634	58.243
	(4.61)**	(2.51)*	(2.66)**	(0.30)	(1.63)	(1.04)	(1.38)
Used oil engines or electric pump sets	0.511	128.800	-1,078.863	352.909	359.924	-114.399	-74.597
	(2.87)**	(1.18)	(2.04)*	(1.35)	(0.87)	(1.19)	(1.41)
Cultivated cotton	0.235	-44.695	4.723	-144.972	-834.697	-12.490	-3.065
	(4.79)**	(2.95)**	(0.04)	(3.78)**	(1.93)	(0.27)	(0.10)
Cultivated tobacco	0.409	-0.149	164.173	58.963	-11.228	-65.438	-83.356
	(5.98)**	(0.01)	(1.20)	(1.39)	(0.04)	(1.31)	(1.91)
Belong to an association	0.215	44.789	163.608	-5.863	-496.694	102.025	20.587
	(2.74)**	(2.44)*	(1.20)	(0.14)	(1.87)	(1.86)	(0.49)
Received information from extension	0.050	27.159	-210.389	-11.666	-156.673	26.057	6.575
	(1.25)	(1.97)	(2.03)*	(0.52)	(1.01)	(0.84)	(0.28)
Extension information in village	0.047	-8.959	31.326	-27.035	-328.288	-11.741	12.674
	(1.15)	(1.05)	(0.39)	(1.10)	(2.11)*	(0.46)	(0.70)
Received information on prices	0.037	13.730	176.593	14.627	33.867	37.731	31.169
	(1.21)	(1.55)	(2.61)**	(0.75)	(0.27)	(1.64)	(1.15)
Information on prices in village	0.046	-7.405	-129.649	-64.984	14.715	6.589	-4.630
	(1.12)	(0.92)	(1.33)	(3.15)**	(0.11)	(0.26)	(0.31)
Old village before Independence	-0.005	-4.004	109.381	13.378	-100.703	-5.075	-14.914
	(0.11)	(0.51)	(1.44)	(0.61)	(0.89)	(0.20)	(0.92)
Houses in village are close together	-0.013	-12.531	198.138	82.034	-39.626	-58.843	42.962
	(0.34)	(1.32)	(2.23) *	(3.07)**	(0.32)	(2.23)*	(2.04)*
Born in the village	0.014	4.464	-53.961	26.261	-388.286	-5.513	-0.951
	(0.48)	(0.61)	(0.72)	(1.48)	(2.72)**	(0.28)	(0.04)
Live near a paved road	0.006	3.051	-31.224	-47.458	-208.806	1.860	-5.295
	(0.14)	(0.26)	(0.34)	(1.35)	(1.33)	(0.07)	(0.24)
Passable road throughout year	0.065	-12.299	5.877	-9.797	213.619	-8.707	-14.041
	(1.41)	(1.30)	(0.07)	(0.36)	(1.37)	(0.31)	(0.62)
Bus transport throughout the year	-0.005	-9.462	58.611	-4.787	10.576	40.511	-2.425
	(0.12)	(1.14)	(0.68)	(0.17)	(0.06)	(1.31)	(0.09)

Appendix Table 1. (cont.)

			Self-employment		Off-farm wage earnings		
Independent variable	**Net crop income[3]**	**Livestock sales**	**Small business**	**Resource extract.**	**Non-agricultural**	**Agricultural**	**Remittances**
11-20 kms or 1 hour to Center	-0.024	5.388	-48.377	-52.224	50.128	78.786	-54.687
	(0.47)	(0.52)	(0.65)	(1.56)	(0.25)	(2.28)*	(2.32)*
21-40 kms or 2-3 hours to Center	0.087	8.549	-110.782	-52.597	-2.596	-30.773	-64.997
	(2.02)*	(0.88)	(1.26)	(1.43)	(0.02)	(0.76)	(2.85)**
More than 40 kms or 3 hours to Center	0.045	31.653	-55.543	-30.654	-187.112	-1.310	-71.295
	(0.91)	(2.07)*	(0.42)	(0.94)	(0.92)	(0.04)	(2.40)*
Missing information on distance	0.068	-12.702	28.235	-77.166	16.817	-15.836	-24.810
	(0.61)	(0.50)	(0.14)	(1.13)	(0.07)	(0.38)	(0.74)
Access to electricity	-0.060	-31.521	-98.205	-52.262	522.129	-49.139	7.534
	(0.82)	(1.80)	(0.51)	(1.14)	(2.00) *	(1.14)	(0.25)
Access to well water in or near village	-0.023	3.159	-67.288	-0.551	246.024	-12.646	-45.276
	(0.58)	(0.33)	(1.04)	(0.02)	(1.94)	(0.50)	(2.53)*
Access to a market in or near village	-0.013	-8.698	7.188	-33.195	26.543	6.270	-2.678
	(0.31)	(0.89)	(0.10)	(1.39)	(0.22)	(0.24)	(0.12)
Factory in the village	0.041	-22.964	732.514	-45.742	250.166	99.327	-60.412
	(0.36)	(1.09)	(2.53)*	(0.87)	(2.07) *	(1.92)	(1.28)
Input supply store in the village	0.014	2.057	-119.083	-27.440	131.136	6.659	-6.244
	(0.24)	(0.20)	(1.31)	(1.04)	(0.71)	(0.22)	(0.29)
Water points for cattle	0.074	16.221	88.288	9.993	432.458	69.515	6.278
	(1.39)	(1.40)	(0.85)	(0.22)	(1.85)	(2.04) *	(0.25)
Access to formal credit	0.034	15.627	189.374	-85.386	33.229	-37.355	43.409
	(0.76)	(1.09)	(1.29)	(1.74)	(0.19)	(0.92)	(1.54)
Maize mill in the village	0.047	16.304	60.588	9.798	325.288	-4.001	20.397
	(1.33)	(1.41)	(0.81)	(0.29)	(1.96)	(0.15)	(1.08)
Adult death in past two years	-0.078	-13.484	79.298	120.853	-494.961	-77.536	47.751
	(1.07)	(1.01)	(0.59)	(1.94)	(1.29)	(1.51)	(0.81)
Adult prolonged illness	-0.042	-13.422	-105.991	-20.973	232.801	-61.802	71.068
	(0.84)	(1.07)	(0.84)	(0.67)	(0.90)	(1.60)	(2.66)**

Appendix Table 1. (cont.)

			Self-employment		Off-farm wage earnings		
Independent variable	**Net crop income[3]**	**Livestock sales**	**Small business**	**Resource extract.**	**Non-agricultural**	**Agricultural**	**Remittances**
Flood risk (index 0-5)[2]	-0.030	-6.526	36.376	25.940	-32.555	7.827	20.175
	(1.09)	(1.30)	(0.57)	(1.62)	(0.29)	(0.44)	(1.73)
Drought risk (index 0-5)[2]	-0.015	11.008	-35.467	-0.120	-39.720	28.544	0.627
	(0.96)	(2.22) *	(0.94)	(0.01)	(0.65)	(1.98)*	(0.08)
Plant pest & disease risk (index 0-5) [2]	-0.031	0.298	-41.601	30.993	-14.817	-20.509	1.775
	(2.86)**	(0.10)	(1.89)	(2.84)**	(0.32)	(2.03)*	(0.36)
Animal disease risk (index 0-5) [2]	0.002	-3.894	61.751	-5.000	-73.681	-0.130	-1.261
	(0.21)	(1.54)	(2.18)*	(0.65)	(1.67)	(0.02)	(0.28)
Received emergency seed	0.167	0.828	9.453	40.177	66.761	-26.419	23.665
	(3.24)**	(0.06)	(0.11)	(1.29)	(0.36)	(0.83)	(0.94)
Crops grown in village: 2-10	0.106	-14.616	-181.291	-4.286	-234.266	-22.487	-126.041
	(1.20)	(0.82)	(1.10)	(0.08)	(0.87)	(0.38)	(2.09)
Crops grown in village: 11-20	0.138	2.749	-165.349	6.745	-368.071	-13.020	-103.849
	(1.40)	(0.13)	(0.85)	(0.11)	(1.14)	(0.20)	(1.70)
Crops grown in village: 20 or more	0.205	-16.021	53.392	-14.875	-317.812	-24.444	-40.715
	(1.87)	(0.64)	(0.23)	(0.20)	(0.78)	(0.32)	(0.56)
Underreported self-employment income	-0.004	-47.612	-49.826	-105.141	341.262	14.459	45.856
	(0.02)	(1.18)	(0.21)	(1.40)	(0.81)	(0.17)	(0.65)
1-9 head of cattle	0.067	-	24.054	58.876	276.918	-1.757	38.012
	(0.76)	-	(0.10)	(1.15)	(0.79)	(0.03)	(0.50)
10 or more head of cattle	0.151	-	1,388.985	-209.750	512.251	38.570	101.795
	(1.58)	-	(1.20)	(2.45)*	(0.85)	(0.62)	(1.23)
1-19 goats	0.032	-	-23.417	-24.301	56.041	-64.806	9.651
	(0.92)	-	(0.31)	(0.95)	(0.41)	(2.00)*	(0.48)
20 or more goats	0.277	-	837.550	-120.303	697.852	-134.320	20.404
	(2.18) *	-	(1.14)	(1.49)	(1.42)	(1.77)	(0.34)
1-29 chickens	0.174	-	62.221	-2.054	-293.199	26.293	-0.468
	(6.72)**	-	(0.80)	(0.10)	(2.25)*	(1.25)	(0.02)
30 or more chickens	0.333	-	88.454	30.018	-205.816	-28.128	-138.041
	(5.27)**	-	(0.56)	(0.59)	(1.00)	(0.45)	(2.81) **
Number of members who earn wages[2]	-0.039	-17.264	-236.997	-32.611	-	-	58.825
	(1.14)	(2.74) **	(3.49) **	(2.07) *	-	-	(3.95)**
No. members who are off-farm self-employed[2]	0.062	1.345	-	-	-483.856	-34.064	-29.149
	(2.29)*	(0.23)	-	-	(3.26)**	(1.73)	(1.95)

Appendix Table 1. (cont.)

			Self-employment		Off-farm wage earnings		
Independent variable	**Net crop income[3]**	**Livestock sales**	**Small business**	**Resource extract.**	**Non-agricultural**	**Agricultural**	**Remittances**
Agroecology[5]	-	-	-	-	-	-	-
2	0.722	-34.231	305.775	55.120	689.126	-252.931	94.041
	(5.88)**	(1.25)	(1.75)	(1.05)	(1.75)	(4.49)**	(1.84)
3	-1.080	16.284	265.131	116.698	406.950	-67.018	32.889
	(10.02)**	(0.55)	(0.96)	(1.60)	(1.07)	(1.11)	(0.58)
4	-0.150	47.911	398.099	84.475	-93.484	-25.572	-46.963
	(0.90)	(1.63)	(1.97)	(1.67)	(0.35)	(0.50)	(0.95)
6	0.330	75.742	359.666	132.636	25.447	-131.194	-37.175
	(1.69)	(2.48)*	(2.38)*	(2.08)*	(0.09)	(1.54)	(0.81)
7	0.105	2.537	-22.223	-75.084	-272.789	-175.367	-29.967
	(1.00)	(0.11)	(0.12)	(1.61)	(0.94)	(3.54)**	(0.63)
8	0.779	21.476	106.309	-35.171	-855.143	-261.159	-59.869
	(6.32)**	(0.85)	(0.51)	(0.74)	(2.18)*	(4.84)**	(1.11)
10	1.417	15.600	-44.466	-59.776	-202.650	-92.984	-64.556
	(11.84)**	(0.57)	(0.23)	(0.91)	(0.63)	(1.31)	(1.04)
Constant	2.200	-274.834	-2286.017	-302.990	-2478.62	-201.171	-340.729
	(11.42)**	(2.76)**	(3.49)**	(2.26)**	(2.81)**	(1.71)**	(3.25)**
Observations	4821	4833	4833	4833	4833	4833	4833
R-squared	0.50	-	-	-	-	-	-
F value		2.00	7.45	10.03	7.44	10.98	9.82
Uncensored observations		1,757	1,397	932	580	337	1,039

[1]In US$, at an exchange rate of US$1 = 23,540 meticais.
[2]Continuous variables; all others are dummy variables 0-1.
[3]ln income.
[4]Absolute value of t statistics in parentheses = * significant at 5%; ** significant at 1%.
[5]Land Sources and Agroecologies are defined in Table 2.

REFERENCES

Appleton, Simon. 2001. The Rich Are Just Like Us, Only Richer: Poverty Functions or Consumption Functions? *Journal of African Economies* 10.4: 433-469.

Boughton, D., D. Tschirley, H.Marrule, A.O.Ofiço, and B.Zulu. 2002. *Cotton Sector Policies in Sub-Saharan Africa: Lessons Behind the Numbers in Mozambique and Zambia.* Flash No. 34E. Maputo: Directorate of Economics, Ministry of Agriculture and Rural Development.

Benfica, R. 1997. *Micro and Small Enterprises in Central and Northern Mozambique: Results of a 1996 Survey*. Research Report No. 27. Maputo: MAP/MSU Food Security Project, Ministry of Agriculture and Fisheries.

Chapoto, A., and T.S. Jayne. 2004. *Analyzing The Factors Explaining The Disparities In Income And Poverty In Zambia: Implications For The Design Of Poverty Reduction Strategies.* Draft Working Paper, East Lansing: Michigan State University.

Binswanger, H.P., and G. Donovan. 1987. *Agricultural Mechanization: Issues and Options*. Washington, D.C.: The World Bank.

Datt, G., and D. Joliffe. 1998. *Determinants of Poverty in Egypt: 1997*. FCND Discussion Paper No. 75. Washington, D.C.: International Food Policy Research Institute.

Datt, G., K. Simler, S. Mukherjee, and G. Dava. 2000. *Determinants of Poverty in Mozambique:1996-97*. FCND Discussion Paper No. 78. Washington, D.C.: International Food Policy Research Institute.

Datt, G. 1998. *Simulating Poverty Measures from Regression Models of Household Consumption*. Washington, D.C.: International Food Policy Research Institute.

Jayne, T.S., T. Yamano, M.T. Weber, D. Tschirley, R. Benfica, A. Chapoto, and B. Zulu. 2003. Smallholder Income and Land Distribution in Africa: Implications for Poverty Reduction Strategies. *Food Policy* 28: 253-275.

Joliffe, D. 2004. The Impact of Education in Rural Ghana: Examining Household Labor Allocation and Returns On and Off the Farm. *Journal of Development Economics* 73: 287-314.

MADER. 2002. *Relatorio Geral Do TIA*. Maputo, Mozambique: Ministry of Agriculture and Rural Development (MADER).

Mather, D., H. Marrule, C. Donovan, M. Weber, and A. Alage. 2004. Analysis of Adult Mortality Within Rural Households in Mozambique: Implications for Policy. Research Report No. 58E. Maputo: Directorate of Economics, Ministry of Agriculture and Rural Development.

MPF (Ministry of Plan and Finance). 2001. Plan de Acção para o Redução de Pobreza Absoluta (2001-2005). (PARPA) Ministerio de Plan e Finanzas. Maputo, Mozambique.

MPF. 2004. Pobreza e Bem-estar em Mocambique: Segunda Evaluação Nacional. Ministerio de Plan e Finanzas. Maputo, Mozambique.

Philips, J. 1986. A Comment on Farmer Education and Farm Efficiency: A Survey. *Economic Development and Cultural Change* 35: 637-641.

Ravallion, M. 1993. Poverty Comparisons A Guide to Concepts and Methods. Washington, D.C.: World Bank.

Reardon, T. 1997. Using Evidence of Household Income Diversification to Inform the Study of Rural Nonfarm Labor Market in Africa. *World Development* 25.5: 735-747.

Tschirley, D., and M.T. Weber. 1994. Food Security Strategies Under Extremely Adverse Conditions: The Determinants of Household Income and Consumption in Rural Mozambique. *World Development* 22.2: 159-173.

Tschirley, D., and R. Benfica. 2000. *Smallholder Agriculture, Wage Labor, and Rural Poverty Alleviation in Mozambique: What Does the Evidence Tell Us?* Research Report No. 41. Maputo: MAP/MSU Food Security Project, Ministry of Agriculture and Rural Development.

Tschirley, D., D. Rose, and H. Marrule. 2000. *A Methodology for Estimating Household Income in Rural Mozambique Using Easy-to-collect Proxy Variables: Technical Report for USAID-Funded NGOs*. Research Report No. 38. Maputo: MAP/MSU Food Security Project, Ministry of Agriculture and Rural Development.

World Bank. 2003. *African Development Indicators*. Washington, D.C.: World Bank.

Working Papers

1E. Informing the Process of Agricultural Market Reform in Mozambique: A Progress Report. October, 1990

1P. Processo de Reformas do Mercado Agrícola em Moçambique: Progressos Alcançados. Outubro de 1990

2E. A Pilot Agricultural Market Information and Analysis System in Mozambique: Concepts and Methods.

3P. Inquérito ao Sector Familiar da Província de Nampula: Observações Metodológicas. Novembro de 1991

3E. A Socio-Economic Survey of the Smallholder Sector in The Province of Nampula: Research Methods (**translated from Portuguese**). January 1992

4P. Inquérito ao Sector Familiar da Província de Nampula: Comercialização Agrícola. Janeiro de 1992

4E. A Socio-Economic Survey in The Province of Nampula: Agricultural Marketing in the Smallholder Sector (**translated from Portuguese**). January, 1992

5P. Inquérito ao Sector Familiar da Província de Nampula: O Algodão na Economia Camponesa. Novembro de 1991

5E. A Socio-Economic Survey in The Province of Nampula: Cotton in the Smallholder Economy (**translated from Portuguese**). January, 1991

6E. The Determinants of Household Income and Consumption in Rural Nampula Province: Implications for Food Security and Agricultural Policy Reform. August, 1992

6P. Determinantes do Rendimento e Consumo Familiar nas Zonas Rurais da Província de Nampula: Implicações para a Segurança Alimentar e as Reformas de Política Agrária (**Traduzido do Inglés**). Fevereiro de 1993

8E. Changing Agricultural Market Policies in Mozambique: Insights from Empirical Information on Farmer and Market Behavior. March 1992

9E. The Maputo Market Study: Research Methods. March, 1993

9P. O Estudo do Mercado de Maputo: Observações Metodólogicas. Junho de 1993

10E. The Organization, Behavior, and Performance of the Informal Food Marketing System in Maputo. May, 1993

12E. The Pricing and Distribution of Yellow Maize Food Aid n Mozambique: An Analysis of Alternatives. October,1993

14E. Liedholm, Carl and Donald Mead, "Small-scale Enterprises: a Profile", in Economic Impact: A Quarterly Review of World Economics, no. 63 (**Reprint**)

14P. Liedholm, Carl and Donald Mead, "O Papel das Microempresas no Desenvolvimento de Pequenas Empresas: Um Perfil", em Economic Impact: A Quarterly Review of World Economics, no. 63 (**Reprint, translated from English)**

15P. Mini-SIMA e Análises Específicas: Um Ensaio Aplicado aos Mercados de Maputo. Julho de 1993

16E. Evolution of the Rural Economy in Post-War Mozambique: Insights from a Rapid Appraisal in Monapo District of Nampula Province. July 1993

17P. Padrões de Distribuição de Terras no Sector Familiar em Moçambique: A Similaridade entre duas Pesquisas Distintas e as Implicações para a Definição de Políticas. May 1994

18E. Who Eats Yellow Maize? Some Preliminary Results from a Survey of Consumer Maize Preferences in Maputo. October, 1994

18P. Quem Come Milho Amarelo? Alguns Resultados Preliminares de um Inquérito sobre as Prefencias dos Consumidores de Milho na Cidade de Maputo (**Traduzido do Inglés**). Novembro de 1994

19P. Diagnóstico da Estrutura, Comportamento, e Desempenho dos Mercados Alimentares de Moçambique. Julho de 1995

20P. Inquérito ao Sector Moageiro de Pequena Escala em Moçambique: Observações Metodológicas. Janeiro de 1995

21E. Smallholder Cash Cropping, Food Cropping and Food Segurity in Northern Mozambique: Research Methods.

21P. O Sector da Castanha de Caju - Lucros Potenciais Perdidos por Africa? (**Reimpressão)**, Novembro de 1995

22E. Smallholder Cash Cropping, Food Cropping and Food Security in Northern Mozambique: Research Methods. March, 1996

22P. Culturas de Rendimento, Culturas Alimentares e a Segurança Alimentar do Sector Familiar no Norte de Moçambique: Métodos do Estudo. Novembro de 1996

23E. Plan of Activities for Food Security Research Project. September 1995 through August 1997, 1996

24E. Strasberg, Paul, “Smallholder Cash-Cropping, Food-Cropping and Food Security in Northern Mozambique”, Ph.D.Dissertation, Dept. of Agricultural Economics, Michigan State University (**Reprint**). May, 1997

25E. Smallholder Cash-Cropping, Food-Cropping and Food Security in Northern Mozambique: Summary, Conclusions, and Policy Recommendations. June, 1997

26E. Agricultural Market Information for Family Farms in Mozambique. June, 1997

26P. Informação de Mercado Agricola para o Sector Familiar em Moçambique. Junho de 1997

27E. Micro and Small Enterprises in Central and Northern Mozambique: Results of a 1996 Survey. September, 1997.

27P. Micro e Pequenas Empresas no Centro e Norte de Moçambique: Resultados do Inquerito Realizado em 1996. Maio de 1998.

28P. Desafios Para Garantir a Concorrência e Reduzir os Custos no Sistema Alimentar deMoçambique. Maio de 1998.

29E. Planning for Drought in Mozambique: Balancing the Roles of Food Aid and Food Markets. May, 1998

29P. Planificando pela Seca em Moçambique: Balanceando os Papeis da Ajuda Alimentar e dos Mercados de Alimentos. Maio de 1988

30P. Séries Históricas dos Preços de Grão de Milho Branco e suas Tendências Reais em Alguns Mercados do País. Maio de 1998.

31E. What Makes Agricultural Intensification Profitable for Mozambican Smallholders? An Appraisal of the Inputs Subsector and the 1996/97 DNER/SG2000 Program, Volume I: Summary. October, 1998.

32E. What Makes Agricultural Intensification Profitable for Mozambican Smallholders? An Appraisal of the Inputs Subsector and the 1996/97 DNER/SG2000 Program, Volume II: Main Report. October, 1998.

33E. Household Food Consumption in Mozambique: A Case Study in Three Northern Districts. February, 1999.

34E. The Effects of Maize Trade with Malawi on Price Levels in Mozambique: Implications for Trade and Development Policy. November, 1999.

35P. Séries Históricas dos Preços de Grão de Milho Branco e Suas Tendências Reais em Alguns Mercados do País no Periódo Compreendido Entre Abril 1993 e Setembro 1999. Novembro de 1999.

36E. A Simplified Method for Assessing Dietary Adequacy in Mozambique. January, 2000.

37E. Implementing A Simplified Method for Assessing Dietary Adequacy in Mozambique: A User's Manual. January, 2000.

38E. A Methodology for Estimating Household Income in Rural Mozambique Using Easy-to-Collect Proxy Variables. February, 2000.

39E. Comparing Yields and Profitability in MADR's High- and Low-Input Maize Programs: 1997/98 Survey Results and Analysis. March, 2000.

40P. Características dos Agregados Familiares Rurais nas Zonas Afectadas pelas Cheias do Ano 2000 no Centro e Sul de Moçambique. Março de 2000.

40E. Representative Characteristics of Rural Households in Areas of Central and Southern Mozambique Affected by The 2000 Floods . Março de 2000.

41P. Sector Familiar Agrícola, Mercado de Trabalho Rural e Alivio da Pobreza Rural em Àreas com Abundância de Terras em Àfrica, Evidência de Moçambique. Março de 2001.

41E Smallholder Agriculture, Wage Labour, and Rural Poverty Alleviation in Mozambique: What Does the Evidence Tell Us? November, 2000.

42E. Smallholder Cashew Development Opportunities and Linkages to Food Security in Nampula Province, Mozambique. November, 2000.

42P. Oportunidades de Desenvolvimento effect Sector Familiar de Cajú e sua Relação com Segurança Alimentar na Província de Nampula, Moçambique. Novembro, 2000.

43E. Constraints and Strategies for the Development of the Seed System in Mozambique. January, 2001.

43P. Constrangimentos e Estratégias para o Desenvolvimento do Sistema de Sementes em Moçambique. Janeiro de 2001.

44P. Prioridades de Investimentos para o Desenvolvimento do Sistema de Sementes em Moçambique. Setembro de 2001.

44E. Investment Priorities for the Development of Mozambique's Seed System. March, 2001.

45P. Avaliação das Necessidades dos Utentes do SIMA. Fevereiro de 2001.

46P. Informação para o Sector Privado Agrícola: Novos Serviços do SIMA e Apoio aos Produtores, comerciantes e processadores do Sector Agrícola. Agosto de 2001

46E Information for the Private Sector in Agriculture: New Information Services from SIMA for Producers, Traders and Processors in the Agricultural Sector in Nampula Province. January, 2002.

47P. Desempenho do Sector Algodoeiro ao Nível da machamba em Nampula: Situação Actual e Perspectivas para o seu Melhoramento

48P Comportamento dos Mercados Grossistas do Milho Branco Durante o Ano 2000. Outubro de 2001

49P. O Desafio do Salário Mínimo: Considerações Teóricas e Práticas. Dezembro de 2001

50P. Passado, Presente e Futuro do Sistema de Informação de Mercados Agrícolas (SIMA). Março de 2002

51E. The Impact of Alternative Agro-Industrial Investments on Poverty Reduction in Rural Mozambique. March 2002

52P. Anuário Estatístico do SIMA. Março de 2002

53P. Qual o Papel da Agricultura Comercial Familiar no Desenvolvimento Rural e Redução da Pobreza em Moçambique.

54E. Gaps And Opportunities For Agricultural Sector Development In Mozambique. April 2003

55P. Sector Comercial de Sementes: Progressos e Perspectivas de Desenvolvimento. Abril 2004

56E. Household Responses to Prime-Age Adult Mortality in Mozambique: Implications for HIV/AIDS Mitigation and Rural Economic Development Policies. (Reprint of paper prepared by David Mather, Cynthia Donovan, Michael Weber, Higino Marrule, and Albertina Alage for the Center for the Study of African Economies Conference, St. Catherine's College, Oxford). March 2004

57E. Determinants Of Rural Income, Poverty, and Perceived Well-Being in Mozambique in 2001-2002. September 2004.

58E. Analysis of Adult Mortality Within Rural Households in Mozambique and Implications For Policy. June 2004.