The Determinants of Household Income and Consumption in Rural Nampula Province: Implications for Food Security and Agricultural Policy Reform

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THE DETERMINANTS OF HOUSEHOLD INCOME AND CONSUMPTION IN RURAL NAMPULA PROVINCE: IMPLICATIONS FOR FOOD SECURITY AND AGRICULTURAL POLICY REFORM

EXECUTIVE SUMMARY

Following ten years of negative growth associated with a highly centralized economic system and an expanding rural insurgency, Mozambique in 1987 embarked on an ambitious reform under the Economic Rehabilitation Program (ERP). At the initiation of the ERP, there was very little household level information regarding the economic behavior of smallholders. Yet such knowledge may be especially important in a situation such as Mozambique's, where the civil war has devastated large areas of the country, disrupting economic activity and displacing millions of people from their homes. This paper utilizes data from a survey of 343 smallholders in northern Mozambique to to begin generating this knowledge, with three principal objectives: first, to describe the range of food security strategies currently employed by rural smallholders in the study zones; second, to identify and explore those factors most closely associated with varying levels of income and consumption among these smallholders; and third, to discuss and clarify the policy implications of these findings for Mozambique.

During June, July, and August, 1991, a survey of 343 smallholders was conducted in 15 villages from Ribaue, Monapo, and Angoche districts of Nampula province. These districts were selected to represent the range of agroecological and human settlement patterns observed in the province. The survey instrument included sections on household structure, purchase and sale of labor, land areas and cropping patterns, production, sales, livestock holdings and flows, input use, expenditures and consumption (24 hour recall), as well as questions regarding farmer perceptions of their situation.

It is important to note that the surveyed villages were randomly selected in each district from the set of villages deemed secure by local officials. Thus, survey results reflect the situation of those households that have been least affected by the war.

Nampula province has historically been one of the breadbaskets of Mozambique. Especially important food crops are maize, cassava, beans, and groundnuts. Despite this, typical food crop yields among surveyed households were only 250 to 800 kg/ha, as compared to a range of 830 to 3,000 kg/ha reported by CIMMYT for the Southern African region. These low yields were found to be related to very low input use on food crops. Seeds are almost exclusively unimproved local varieities, and no farmers reported using fertilizer. In addition to food crops, cotton (Monapo) and cashew (Monapo and Angoche) are commonly grown by smallholders. Cashew's importance in Ribaue had been greatly reduced by a recent pest problem.

Results indicate that incomes are low and variable in each district, and highly correlated with land holdings. Calorie consumption is also low and variable, with many families in each district not achieving even 80% of calorie requirements. Calorie consumption, like income, was also found to be strongly dependent on land holdings. Relatively land rich households nearly all reached at least 80% of requirements, while most land poor households did not.

Cotton production, when combined with pesticide use, was found to have significantly positive impacts on cash income from agricultural sales in Monapo, but not in Ribaue. Importantly, cotton production does not appear to compromise a household's calorie production, as cotton farmers produce more calories per hectare of land in food crops than do non-cotton farmers. It was found that cotton production may compete with off-farm income earning opportunities, thus reducing its

positive effect on total household income. Cashew production contributes very significantly to sales income, does not compete with off-farm labor, and thus has a greater net effect on total income than does cotton. Cashew production does not compete with food production.

Evidence also indicates clearly that many households are constrained in their access to land. Labor availability and land abandonment due to the war do not appear to be the principal causes. Other possibilities include constrained land expansion (as opposed to land abandonment) due to the war, and an inequitable land tenure system. Survey evidence is not sufficient to distinguish clearly the relative importance of these two factors, but the paper suggested that it is implausible to ascribe all the observed inequality to the war. The authors suggest further research, but emphasize that the issue of land access for all smallholders, not just *deslocados*, deserves serious attention from policy makers.

The effects of apparently unequal access to land on the welfare of land poor households are compounded by a lack of stable off-farm income earning opportunities, and by serious failures of rural food markets for purchase. Purchased food is often not available, and when it is, survey evidence indicates that it is many times more expensive per calorie than food produced on the farm. As a result, surveyed smallholders have adopted a strategy of marked reliance on farm based own production to ensure their survival. This makes them very dependent upon the amount of land they have to cultivate.

Smallholders and policy makers in Mozambique are thus faced with a set of difficult and interrelated problems. Very low yields from existing technologies, in combination with unequal land distribution, mean that food must be available for purchase if many households are to meet their consumption needs. But in a market setting, this food will not be made available without sufficient effective demand, and this demand will not emerge unless smallholders can increase their cash incomes through off-farm work or greater sales of cash or food crops.

It was suggested that cotton growing enterprises may offer one way out of this quandary. By generating significant amounts of cash income in relatively small geographical areas, such enterprises might provide the base of effective demand needed for the emergence of stronger markets for food purchases. This will in turn make it possible for land poor farmers to use the increased income earning opportunities offered by cash cropping and off-farm labor to improve their consumption. Insights from research on how best to organize these enterprises may also be of use in designing policy for the production and marketing of cashew, tobacco, and tea.

As the rural marketing system develops over time, the dominance of land holdings in determining household income and consumption will decrease. But land holdings will remain very important for the welfare of most rural households for the foreseeable future. Thus, improved technology for cash and food crop production, and further household level research on land access in the smallholder sector should both be accorded high priority. Land research should emphasize sorting out the relative importance of the war versus long term structural factors in leading to the current unequal distribution of land within the smallholder sector, and should identify specific means to ameliorate the effects of this distribution on the income and consumption of the most land poor households.

METHODOLOGICAL NOTE

This note refers to the estimation of equations 1 and 3 on page 24.

The model as estimated uses actual rather than predicted cotton area (COTAREA) on the RHS of the two equations, despite probable simultaneity with both calorie production (KPROD) and off-farm income (INCOFF). This approach was taken due to very low R^2's when initially instrumenting COTAREA. Using the predicted value in this instance would have given meaningless results on two key issues: 1) what is the impact of cotton growing on calorie production? (especially important in light of widespread food market failure for purchases) and 2) does cotton production compete with off-farm income earning opportunities?

Later attempts at instrumentation were more successful, with R^2's of between .72 and .82. Results for equation 1 (KPROD) in Monapo using predicted COTAREA show very similar adjusted R^2's and the same set of significant variables (at α=.10; see Tables E1 and E2 below for complete regression results). Coefficient values on significant variables generally change very little. In Ribaue, OUTMIG significance level (ρ) changes from .114 to .083, with very little change in the estimated coefficient. POLYG ρ changes from .031 to .103, with a decrease of 50% in the estimated coefficient. No other variables changed significance, and coefficient estimates for other significant variables changed very little. **Based on these results, substantive conclusions do not change**.

For equation 3 (INCOFF), adjusted R^2's are also very similar. Cotton area (COTAREA), negative but insignificant in both Monapo and Ribaue before instrumenting, remains negative after instrumentation, becoming significant in Monapo (ρ=.021) and nearly significant in Ribaue (ρ=.120). **Thus, the suggestion that cotton production competes with off farm income earning opportunities (see pp. 27 and 29) is strengthened with the IV analysis**.

Table E1. Regression Results for Calorie Production (KPROD) Using Actual and Predicted Values of Cotton Area (COTAREA)

	Monapo		Ribaue	
	Actual COTAREA	Predicted COTAREA	Actual COTAREA	Predicted COTAREA
POLYG	-233.3 (.771)	-366.1 (.642)	1763.3(.031)	956.8 (.103)
FEMHEAD	-2615.1 (.015)	-1875.6 (.061)	-715.5 (.572)	-784.2 (.366)
DEP_RAT	-20.4 (.064)	-25.8 (.020)	-38.9 (.007)	-27.3 (.015)
AGEHHH	-34.4 (.104)	1.2 (.957)	19.6 (.358)	13.7 (.468)
NADULT	-80.1 (.735)	-267.3 (.330)	-451.8 (.059)	-393.9 (.048)
EDHHH	-861.8 (.115)	-250.7 (.658)	1036.8 (.121)	592.5 (.289)
TOTAREA	4104.6 (.000)	3801.8 (.000)	2723.5 (.000)	2662.3 (.000)
COTAREA	-14.7 (.196)	-13.7 (.368)	10.7 (.706)	44.1 (.117)
CASHEW	61.1 (.000)	46.4 (.001)	-31.6 (.906)	-111.2 (.650)
LVST	-.006 (.645)	-.01 (.454)	-.013 (.456)	-.007 (.677)
OUTMIG	1683.6 (.056)	1844.6 (.056)	-1281.7 (.114)	-1209.6 (.083)
FAL_CUL	-1.5 (.669)	-1.30 (.716)	1.0 (.843)	.509 (.901)
Constant	4098.0 (.003)	3426.5 (.013)	3404.5 (.034)	3024.6 (.020)
Adj. R_2	.586	.531	.368	.376

Table E2. Regression Results for Off-farm Income (INCOFF) Using Actual and Predicted Values of Cotton Area (COTAREA)

	Monapo		Ribaue	
	Actual COTAREA	Predicted COTAREA	Actual COTAREA	Predicted COTAREA
POLYG	47999.8 (.004)	57592.7 (.001)	-3303.8 (.652)	1551.6 (.895)
FEMHEAD	-3116.0 (.883)	-14390.1 (.507)	-12392.9 (.285)	-22251.6 (.205)
DEP_RAT	188.2 (.388)	227.4 (.341)	173.4 (.174)	-103.8 (.640)
AGEHHH	-225.4 (.591)	-581.8 (.223)	5.1 (.979)	276.0 (.469)
NADULT	2917.6 (.537)	3532.4 (.556)	276.3 (.898)	-2644.1 (.493)
EDHHH	11318.8 (.298)	9004.0 (.469)	-6374.6 (.293)	-7770.8 (.491)
TOTAREA	9492.8 (.531)	7432.3 (.651)	-3216.8 (.586)	2903.8 (.795)
COTAREA	-267.0 (.240)	-780.8 (.021)	-311.4 (.231)	-882.8 (.120)
CASHEW	27.9 (.915)	118.4 (.687)	1742.7 (.474)	3512.1 (.478)
LVST	.891 (.002)	.959 (.002)	-.032 (.841)	-.344 (.281)
OUTMIG	30586.2 (.081)	11892.4 (.569)	-2447.1 (.738)	-7837.0 (.574)
FAL_CUL	39.1 (.577)	70.7 (.367)	-15.7 (.732)	5.3 (.949)
Constant	-2699.5 (.920)	23017.8 (.438)	9739.2 (.498)	26588.8 (.306)
Adj. R_2	.221	.250	-.090	-.042

THE DETERMINANTS OF HOUSEHOLD INCOME AND CONSUMPTION IN RURAL NAMPULA PROVINCE: IMPLICATIONS FOR FOOD SECURITY AND AGRICULTURAL POLICY REFORM

INTRODUCTION AND OBJECTIVES

Following ten years of negative growth associated with a highly centralized economic system and an expanding rural insurgency, Mozambique in 1987 embarked on an ambitious reform under the Economic Rehabilitation Program (ERP). The central premise of the ERP was that this long economic decline could be halted and perhaps reversed (subject to the ending of the violence) through macroeconomic and sectoral reforms which removed price distortions, improved price incentives for agricultural producers, and eliminated regulatory barriers to the emergence of efficient and effective markets. Key objectives in the food and agricultural sector included increasing smallholder production and marketed surplus of food, and integrating smallholders into cash crop production schemes. In part, these goals were seen as means toward simultaneously reducing the country's dependence on food imports (almost entirely concessional) and reversing its steep decline in foreign exchange earnings.

At the initiation of the ERP, there was very little household level information regarding the economic behavior of smallholders. Yet as Weber et al. argue, the diversity of smallholder economic behavior makes it imperative that food security and structural adjustment policies be deeply rooted in such empirical knowledge. This knowledge may be especially important in a situation such as Mozambique's, where a civil war that began in the late 1970's has devastated large areas of the country, disrupting economic activity and displacing millions of people from their homes. Yet for many, perhaps the majority of smallholders, the threat is intermittent rather than constant, and its long term nature means that production and marketing activities must go on in as normal a fashion as possible. But even intermittent violence may have enormous impacts on physical infrastructure and on the risks (for both farmers and traders) associated with commercial activity.

This paper utilizes data from a survey of 343 smallholders in northern Mozambique to to achieve three objectives: first, to describe the range of food security strategies currently employed by rural smallholders in the study zones; second, to identify and explore those factors most closely associated with varying levels of income and consumption among these smallholders; and third, to discuss and clarify the policy implications of these findings for Mozambique. Throughout, results from Mozambique will be compared to those from other SSA countries.

INSIGHTS FROM OTHER SUB-SAHARAN AFRICA RESEARCH

Over the past decade, a large body of research has helped to dispel the myth of the self-sufficient African smallholder. This work has shown not only that the large majority of smallholders participate in rural food markets, but that significant numbers of them buy more food than they sell (thus being defined as "net buyers" of food). Complementary research has shown that smallholder participation in the market economy extends beyond food crop markets to markets for cash crops,

agricultural and non-agricultural labor markets, and other factor markets. Work in Mali (Staatz, et al.) shows that more households participate in the market in this way in areas where agricultural potential is lowest, and that these households tend to achieve levels of food security that are at least as great as those in areas of higher agricultural potential but less diversified economic activity. Similar results have been found in Burkina Faso (Reardon, et al.).[1]

This increasingly accepted view of African smallholders operating within a system of agricultural and non-agricultural markets has led more recently to an examination of the impact on the options open to the household when one or more markets within this system do not function effectively. For example, rural food markets often do not provide stable and low cost supplies throughout the year for purchase by rural households. If smallholders cannot depend on these markets whenever they need them, this limitation will affect the type of food security strategy the household adopts. Also, rural labor markets often do not provide year round opportunities for stable off-farm earnings. This too will affect the strategies a household chooses to ensure its survival. Researchers have recently used these conditions to explain the observation that smallholders often do not respond to cash crop price incentives as strongly as policy makers expect (De Janvry,et al.; Fafchamps). Work in Zimbabwe uses survey data to explain a similar lack of responsiveness to cash crop production. This research shows that it makes economic sense for many smallholders not to produce cash crops in this country because the government has instituted polices that make maize meal for purchase very much more expensive then maize grain for sale. Given the high cost of purchased meal, smallholders rationally choose to assure themselves a sufficient supply of maize from own production before they produce cash crops.

Despite these problems, many smallholders throughout Africa have adopted a more commercial orientation over the past two decades, selling more food crops, and expanding into the production of cash crops. Where this has happened, most research shows a highly positive effect on income (von Braun et al., 1991; 1989a; 1989b; Kennedy, 1989; Kennedy and Cogill, 1987). These same studies generally show that the increased income from commercial activities has a positive, though sometimes an unexpectedly small impact on calorie consumption.

Thus, research to date indicates that most African smallholders are actively involved in the market economy, that many are in fact net food buyers, and that many have also diversified their income sources beyond on-farm activities. Further, these trends seem to be strongly associated with increased income and significantly but less strongly associated with improved household food security. The next sections of this paper will examine the extent to which this pattern holds true in Mozambique. The final section will discuss the policy implications of the findings.

STUDY SETTING AND METHODS

During June, July, and August, 1991, a survey of 343 smallholders was conducted in 15 villages from three districts of Nampula province in northern Mozambique. The districts were Ribaué in the interior, Angoche on the coast, and Monapo, situated in a transition zone between the two. They were selected to represent the range of agroecological and human settlement patterns observed in the province.

The survey instrument included sections on household structure, purchase and sale of labor, land areas and cropping patterns, production, sales, livestock holdings and flows, input use, expenditures

[1] See also Haggblade, et al. and Reardon (1990) for a review of evidence on farm and non-farm income sources of sub-Saharan African smallholders.

and consumption (24 hour recall), as well as questions regarding farmer perceptions of their situation.

It is important to note that the surveyed villages were randomly selected in each district from the set of villages deemed safe by local officials for enumerators and supervisors. Thus, survey results reflect the situation of those households that have been least affected by the war. Actions such as land abandonment or physical displacement directly due to violence are therefore expected to be under represented in the sample. But at the same time, it is expected that sampled households were affected by the indirect but extensive consequences of the war on physical infrastructure and the agricultural marketing system.[2]

Confining the sample to villages without large numbers of displaced (*deslocado* and *afectado*) households will help to understand better the growth potential and related constraints of the smallholder sector. The need to relocate displaced and refugee families after the arrival of peace, and to assure adequate access to land for these families, is well known and actively discussed in the on-going policy debate. The situation and prospects for smallholders located in areas where violence has not forced large scale relocation are less debated and less well informed. For example, the 1989 Food Security Assessment of the Ministry of Commerce and World Bank acknowledges a lack of good information, and reasons that it is logical to expect some food security problems among these smallholders. Nonetheless, it states that households not classified as *deslocado* or *afectado* "are assumed to be self-provisioning" (p. 34). This reflects the common assumption, based largely on a lack of information, that these households are able, or at least will be able after the war, to produce adequate food to feed themselves and also to generate some marketed surplus for the cities. Results from this survey will allow that assumption to be critically examined.

Agricultural Production Characteristics

Nampula province, and Zambezia province just to the south, have historically been considered the bread baskets of Mozambique. In 1981 (prior to the onset of the worst rural violence), these two provinces accounted for 39% of the total national marketed output of maize, 84% of the cassava, 73% of the beans, and 93% of the groundnuts. As indicated in Table 1, cassava is grown by nearly all households in all three surveyed districts. Other important food crops in the interior (Ribaue) are beans, maize and sorghum. Maize and sorghum are far less important on the coast (Angoche), where rice and peanuts play a much greater role.

Despite the historical importance of these areas in the national food supply, food crop yields appear to be relatively low compared with other Southern African countries. Typical maize yields (generally intercropped) among surveyed households during 1991 ranged between 400 and 800 kg/hectare in Monapo, between 250 and 600 kg/hectare in Ribaué, and between 200 and 400 kg/hectare in Angoche. CIMMYT quotes average maize yields of between 830 and 3,000 kg/hectare among low input smallholders in the Southern African region (Low, et.al., 1990).

[2] In Ribaue and Monapo, it is believed that the sampled villages are broadly representative of their districts. However, insecure (and therefore unsurveyed) villages in Angoche tended to be closest to the coast (where fishing presents an additional off-farm income opportunity), and to cashew and rice processing facilities. Thus, the sample in Angoche may underestimate the importance of off-farm income for that district.

Table 1. Percentage of Households Growing Selected Crops and Mean Quantity Produced by Those Households Growing, by District

	Monapo		Ribaue		Angoche	
Crop	% Growing	Quant. Produced (kg)	% Growing	Quant. Produced (kg)	% Growing	Quant. Produced (kg)
Maize	54	376	76	407	36	159
Cassava[1]	97	876	97	773	100	795
Beans	78	79	92	161	65	95
Sorghum	25	149	72	213	07	91
Rice	14	154	40	93	80	223
Peanut	23	113	28	128	76	149
Cotton	57	384	14	105	0	0
Cashew	56	168	6	142	63	372

[1] Dry weight
Source: Nampula Smallholder Survey

These low yields are related to the very low input use on food crops. No surveyed smallholder reported using pesticides or fertilizer (either chemical or organic) on their food crops, and nearly three-quarters used unimproved local seeds obtained from neighbors. The use of improved varieties and hybrids, and of fertilizer and pesticides are all below practices identified as "typical" by CIMMYT for the Southern African region.

Nampula has a long history of smallholder cash crop production for export. Chief among these are cotton and cashew nut. Tobacco production, once quite important in Ribaué and districts to the west, is now insignificant. During the colonial era, cotton was produced with forced labor on the fields of Portuguese producers, and through coerced cultivation on smallholders' own plots. Following independence, production dropped dramatically, but has begun to rebound in recent years, as major new cotton growing enterprises have been initiated in collaboration with foreign agribusiness firms. In Monapo, a Portuguese company operates its own farm and factory, hiring labor from among the surrounding smallholders. Over half of the smallholders surveyed in this district also cultivate the crop on their own fields and sell to the company, to which the government has granted a monopsony. Eighty one percent of these growers intend to plant cotton again next year. A much smaller proportion of smallholders cultivate cotton in Ribaué, where yields averaged only 11% of those in Monapo. Only 8% of growers in Ribaué plan to continue production next year. Cotton is not grown in Angoche, due to unfavorable climatological conditions.

Cashew production has also fallen since independence, but remains a very important source of income for smallholders in Angoche and Monapo. Sixty-three percent of sampled households in Angoche have cashew trees, tending to an average of 56 each. Numbers in Monapo are similar. In Ribaué, only 41% have trees, and a disease problem recently has reduced average trees harvested per household to five. Earnings from cashew in Ribaué had been quite significant prior to the onset of this problem. Yields per tree harvested in Angoche are more than double those in Ribaué and Monapo.

Land Access

The issue of land distribution has taken an increasingly important place in the national debate in recent years.[3] Despite this, few if any comprehensive studies exist of land access conditions in the smallholder sector. A study based on pre-independence data suggested that land concentration in the Mozambican smallholder sector was similar to that found in the smallholder sectors of Malawi, Ivory Coast, and Nigeria (Ghai and Radwan, p. 11). More recent studies, based on secondary data, report average smallholder land holdings ranging from 1.5 ha (Bruce) to between 2.0 and 2.5 ha (World Bank). These latter studies do not address the important issue of land distribution within the smallholder sector.

Data from this survey begin to shed some light on this issue. Table 2 breaks sampled households into land area quartiles, based on four different definitions of land size. Cultivated land per household, and cultivated plus fallow land per household are the measures most often used by researchers, and should be familiar to all readers. These measures show mean cultivated land sizes per household of between 1.1 ha in Angoche and 2.3 ha in Ribaué. These measures also show some degree of concentration of land, with approximately 40% to 50% of all land being held by the largest 25% of smallholders. These same smallholders cultivate, on average, between four and five times more land per household than the smallest 25%.

But an alternative measure of land holdings, land per consumption adult equivalent (AE), may give a more adequate picture of land distribution.[4] The concept of adult equivalent is very commonly used in socioeconomic research. It is similar to the concept of *per capita*, but is based on the observation that not all members of a household need the same number of calories to remain healthy. For example, an adult woman or a child do not need to consume as much as an adult male. For this reason, they are not counted as heavily as an adult male. A potentially useful way to think of one of the common measures in this paper - cultivated land per AE - is that it measures the amount of land a household has relative to the size of mouths it has to feed, where a child's "mouth" is not as large as an adult's. Thus, since

[3] See, for example, Carrilho, et. al. (1990), Martins (1992a and 1992b), and various issues of the magazine Extra.

[4] This consumption adult equivalent is based on FAO calorie requirements for "normal" activity levels. Adult equivalents are: males 10 or older = 1; females 20 or older = .72; females 10-19 = .84; and children less than 10 = .60.

Table 2. Household Land Holdings by Surveyed Districts of Nampula Province, 1991

District/ Land Area Quartile[3]	Land Holding Per Household				Land Holding Per Household Adult Equivalent[1]			
	Cultivated (Ha)	% of Area Held	Cult. & Fal.[2] (Ha)	% of Area Held	Cultivated (Ha)	% of Area Held	Cult. & Fal.[2] (Ha)	% of Area Held
Monapo	**1.59**		**2.14**		**.56**		**.77**	
Quart. 1	.56	.08	.73	.08	.20	.09	.25	.09
Quart. 2	1.11	.19	1.53	.19	.36	.17	.50	.14
Quart. 3	1.70	.28	2.19	.27	.60	.25	.75	.25
Quart. 4	3.04	.45	4.14	.46	1.09	.50	1.60	.53
Ribaue	**2.42**		**3.49**		**.69**		**1.0**	
Quart. 1	1.03	.11	1.20	.09	.26	.10	.30	.08
Quart. 2	1.89	.19	2.72	.19	.50	.18	.69	.18
Quart. 3	2.84	.31	4.02	.31	.74	.27	1.09	.27
Quart. 4	4.00	.39	6.12	.41	1.27	.45	1.96	.47
Angoche	**1.09**		**1.51**		**.39**		**.54**	
Quart. 1	.49	.09	.59	.09	.14	.07	.17	.07
Quart. 2	.74	.18	.98	.16	.24	.14	.33	.15
Quart. 3	1.00	.22	1.49	.26	.36	.23	.50	.24
Quart. 4	2.08	.51	2.90	.50	.82	.55	1.15	.53

[1] See footnote #3 for definition of Adult Equivalent.

[2] Mean area for all households.

[3] Quartiles divide households from each district into four groups of equal size, based on the measure of land area utilized.

Source: Nampula Smallholder Survey.

different families have different numbers of members and differing proportions of adults and children, measuring a household's land per AE gives a better indication of how truly "land rich" or "land poor" it is. Even under an equitable land tenure system, land holdings per household would be expected to vary in accordance with the size of households. Those with more mouths to feed would need, and therefore would obtain, more land. Thus, land holdings per AE (per mouth to feed) would be expected to be far less variable across households. But Table 2 shows this not to be the case. In fact, in every district, the share of all land held by the largest 25% of smallholders rises when land is measured per AE as opposed to per household. And in two out of three districts, the share of the smallest 25% falls. Thus, contrary to expectations, land concentration appears to increase when measured in AE terms. The issue of land access will be treated in much more detail later in this paper.

The Civil Unrest

The civil unrest appears as a key subtext accompanying villagers' normal routines. Daily activities are only occasionally interrupted by actual violence, but all endeavors are made more difficult by the accumulated impact of the violence on physical infrastructure and on the transactions costs (already high in Sub-Saharan Africa) associated with any economic activity. Fifty-three percent of all respondents made some direct reference to the war, but most of these came in response to an open question at the end of the interview (Table 3). The specific action most often tied explicitly to the war was land abandonment. Seventeen percent cited security problems as a reason for abandoning land. But overall, 46 percent had abandoned some land, and most cited principal reasons other than the war. More than three-quarters of all villagers indicated that small livestock (principally chickens) had been stolen or slaughtered by "the bandits", and many indicated informally that for this reason they no longer held livestock of any kind.[5]

Table 3. Percentage of Respondents Attributing Specific Actions or Conditions to the Rural Insurgency

Action/Condition Caused by the Insurgency	District		
	Monapo	Ribaué	Angoche
	------ % of Households Sampled ------		
Moved to New Village	9.2	12.6	9.6
Abandoned Land	22.0	16.0	13.9
Do Not Tend Cashew Trees	10.1	5.9	9.6
Marketing is More Difficult	5.5	9.2	0.9
Life is worse, compared to five years ago	45.9	24.4	37.4

Source: Nampula Smallholder Survey

[5] Tsetse fly prevents the holding of large livestock in northern Mozambique.

As reported in a separate paper (MOA/MSU/UA, 1992a), sixty percent of respondents indicated that, despite the war, they had increased the marketing of at least one crop over the past five years. Large majorities in Monapo and Angoche (82% and 95%, respectively) felt that marketing had become easier over the same period. In Ribaué, where the war has been felt most acutely, 64% felt that marketing had become more difficult. Overall, 34% felt that their life had become generally better during this time, while 6% noted little change.

OVERVIEW OF INCOME AND CONSUMPTION PATTERNS

The design of the survey instrument allowed a direct estimate of household income, defined to include food retained for own consumption, all crop and livestock sales, livestock slaughter, cash and in-kind payments received off the farm, and remittances, net of cash and in-kind payments made to hired labor. Household incomes are very low in all three districts (Table 4). Interestingly, average incomes per adult equivalent are lowest in Ribaué (less than 90,000 MT), where land holdings are largest, and highest in Angoche (slightly more than 140,000 MT), where land holdings are smallest.[6] Nevertheless, incomes within each district are strongly and positively associated with land holdings, especially in the upper land area quartiles. This association is strongest in Angoche, where the households in the largest land area quartile have mean incomes per AE that are nearly five times the levels in the lowest quartile. In Ribaué this ratio is nearly three to one, while in Monapo it is only slightly above two to one.

[6] These figures may underestimate normal year incomes, since farmers responded in two thirds of all cases that production was below normal during the year surveyed. Also, informal conversation with farmers and traders also indicates that harvests over the past 3 or 4 years have never equalled those obtained in 1987 and 1988.

Table 4. Household Income and Consumption Indicators by District and Adult Equivalent Land Area Quartile

District/Indicators	Adult Equivalent Land Area Quartile[1] 1	2	3	4	Sample Average
Monapo					
Cultivated Ha/AE	.11-.29	.30-.44	.45-.71	.72-2.33	
Net HH Income/ae (MT)	100,108	98,113	108,578	216,438	131,642
Cal/ae/Day	1,796	2,383	3,648	5,696	3,390
% HH's Reaching 80% of Calorie Requirements	36	70	83	97	72
Ribaue					
Cultivated Ha/AE	.07-.35	.36-.59	.60-.89	.90-4.00	
Net HH Income/ae (MT)	59,217	62,278	78,042	159,691	89,188
Cal/ae/Day	1,722	2,089	2,771	4,620	2,785
% HH's Reaching 80% of Calorie Requirements	34	47	78	97	64
Angoche					
Cultivated Ha/AE	.07-.17	.18-.26	.27-.43	.44-1.84	
Net HH Income/ae (MT)	53,339	137,345	108,975	243,130	140,600
Cal/ae/Day	1,379	2,550	2,428	3,469	2,515
% HH's Reaching 80% of Calorie Requirements	22	63	49	61	49

[1] Cultivated Land Only

Source: Nampula Smallholder Survey

Calorie availability is also quite variable and, within each district, is highly associated with land holdings per AE.[7] [8] Across districts, this relationship between land holdings and calorie availability is less strong, as shown by average availability in Monapo exceeding that in Ribaué. On average, households in each district are at or near the FAO requirement of 2,500 calories per day for a "normally active" adult African male, but many households fall well below this level. Using 80% of the FAO standard as a cutoff for households at serious nutritional risk, Monapo shows the smallest proportion of at risk families, followed by Ribaue and finally Angoche. In the latter, over half of all households appear to be seriously compromised. Nutritional adequacy is most strongly correlated with land holdings in Monapo and Ribaué, where the percentage of households achieving at least 80% of requirements rises from approximately one-third in the smallest quartiles to nearly 100% in the largest.

SMALLHOLDER INCOME AND FOOD SECURITY STRATEGIES

The strategies a household utilizes to maximize its income and food security are revealed by a number of factors, including the relationship it has established to the food market, the various means it has chosen to generate income, the manner in which it has chosen to spend its cash income, and finally the sources it utilizes to obtain calories. This section will examine each of these factors and compare results to those obtained in other SSA research.

Food Crop Market Orientation

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[7] Net availability is calculated as follows:

$$Ka = KP - (KS + KD + KL) + (KR + KB)$$

Where, Ka = net calories available for consumption,
KP = calories produced,
KS = calories sold,
KD = calories used for seed
KL = calories paid in-kind to hired labor,
KR = calories received in-kind for work off-farm, and
KB = calories purchased

Two points should be noted. First, it does not consider calories given or received through traditional exchange mechanisms. These were mentioned with some frequency in the survey, but are not expected be a significant net source of calories except possibly for elderly households. Second, the calculation does not include changes in food stocks, thus assuming that there was no change from year to year. This assumption seems acceptable for the majority of households, since the security situation makes holding stocks so risky. It is thought for this reason that households attempt to carry few stocks out of the hungry season into the next harvest season.

[8] No adjustment is made in the table for pregnant and lactating women, since no data was gathered at the household level regarding this issue. But pregnant women require 16% more calories, and lactating women 25% more calories than other adult women. In Mozambique, approximately 50% of women aged 15 to 45 are pregnant or lactating at any given time (Salvaggio). Thus, figures in the table likely overstate actual calorie availability relative to needs.

Table 6. Percentage Of Weeks In Which Products Were In Short Supply Or Unavailable In Principal District Markets (May 1991 - April 1992)

District/Supply Status	Product					
	White Maize Meal	Yellow Maize Meal	Nhemba Bean	Manteiga Bean	Cassava	Rice
	------ % of Weeks ------					
Monapo						
Short Supply	48.8	24.4	50.0	21.1	48.8	29.2
Unavailable	---	36.6	20.0	78.9	30.8	36.5
Total	48.8	61.0	70.0	100.0	79.6	65.7
Ribaue						
Short Supply	41.7	---	16.7	10.8	---	2.7
Unavailable	33.3	100.0	69.4	89.2	100.0	94.6
Total	75.0	100.0	86.1	100.0	100.0	97.3
Angoche						
Short Supply	69.2	21.1	31.7	10.8	48.8	13.9
Unavailable	---	73.7	52.6	86.5	---	72.3
Total	69.2	94.8	84.3	97.3	48.8	86.2

Source: Agricultural Market Information and Analysis System (AMIAS), Mozambique

Five results stand out. First, on-farm income represents a very high proportion of total income (approximately 85%) in all three districts. These figures compare with ranges of 57% - 66% found by Reardon et al. in three zones of Burkina Faso, 29%-55% by Staatz et al. in two zones of Mali, and a figure of 62% by Kennedy and Cogill in southwestern Kenya. Von Braun et al. in the Gambia most closely approached these results, finding that 77% of total income was generated on smallholders' farms. In a more comprehensive but less current review, Haggblade et al. did not find on-farm shares as high as 85% in any of ten sub-Saharan African countries. This, despite using data primarily from the 1960's and early 1970's, when agriculture was presumably less commercialized than it is now in most countries.

Second, the share of local off-farm income varies little by geographic region, but does vary by farm size in Monapo and Ribaué. In these two districts, the off-farm share falls as land per adult equivalent increases. This negative relationship between farm size and the off-farm income share is consistent with the hypothesis that some households have constrained access to land, and that this is pushing them towards diversification beyond agriculture. Overall, the generally low off-farm share is understandable, given the effect of the rural violence on the willingness and ability to invest in non-

farm enterprises.

Table 7. Household Income Shares By District

Income Source	District		
	Monapo	**Ribaue**	**Angoche**
	------ % of Gross Household Income ------		
On-Farm			
Staple Food Retained For Consumption	40.0	63.7	37.3
Food Sales	5.9	11.9	23.4
Cotton Sales	20.4	1.3	.0
Cashew Sales	8.7	.2	13.7
Livestock Sales	1.6	1.7	.9
Livestock Slaughter/Retained	1.8	3.2	1.5
Other Ag Sales	5.3	5.3	6.8
Drinks	.1	.5	.1
Total On-Farm	**83.8**	**87.8**	**83.7**
Off-Farm			
Cash Payments From Off-Farm	15.8	10.2	15.8
In-Kind Payments From Off-Farm	.1	.7	.3
Remittances	.3	1.2	.2
Total Off-Farm	**16.2**	**12.1**	**16.4**
Cash Payments To Labor	-.5	-.1	-1.2
In-Kind Payments To Labor	-.8	-1.6	-1.2
TOTAL NET INCOME (MT)	**382,748**	**326,127**	**388,483**

Source: Nampula Smallholder Survey

Table 8. Household Income Shares By Adult Equivalent Land Area Quartile, Monapo

Income Source	Adult Equivalent Land Area Quartile[1]				District Average
	1	2	3	4	
	------ % of Gross Household Income ------				
On-Farm					
Staple Food Retained For Consumption	39.8	35.5	41.4	43.6	40.0
Food Sales	1.4	6.1	7.2	8.8	5.9
Cotton Sales	16.9	26.0	25.0	13.8	20.4
Cashew Sales	3.6	11.2	5.8	13.6	8.7
Livestock Sales	.9	.6	1.5	3.3	1.6
Livestock Slaughter	1.4	1.5	2.9	1.6	1.8
Other Ag Sales	8.0	2.6	5.8	5.1	5.3
Drinks	.2	.0	.0	.0	.1
Total On-Farm	**72.2**	**83.5**	**89.6**	**89.8**	**83.8**
Off-Farm					
Cash Payments From Off-Farm	27.4	16.2	10.3	9.4	15.8
In-Kind Payments From Off-Farm	.3	.2	.0	.0	.1
Remittances	.0	.0	.2	.8	.3
Total Off-Farm	**27.7**	**16.4**	**10.5**	**10.2**	**16.2**
Cash Payments To Labor	-.1	-.3	-.7	-1.1	-.5
In-Kind Payments To Labor	-.5	-.4	-.6	-1.5	-.8
TOTAL NET INCOME (MT)	**347,109**	**313,938**	**337,751**	**526,814**	**382,748**

[1] Based on Cultivated Land Only

Source: Nampula Smallholder Survey

Table 9. Household Income Shares By Adult Equivalent Land Area Quartile; Ribaue

Income Source	Adult Equivalent Land Area Quartile[1]				District Average
	1	2	3	4	
	------ % of Gross Household Income ------				
On-Farm					
Staple Food Retained For Consumption	62.6	65.0	64.2	63.2	63.7
Food Sales	7.9	11.4	12.2	16.0	11.9
Cotton Sales	.0	2.3	1.3	1.7	1.3
Cashew Sales	.4	.0	.0	.3	.2
Livestock Sales	2.0	1.0	1.6	2.3	1.7
Livestock Slaughter	4.1	2.4	4.0	2.5	3.2
Other Ag Sales	5.0	3.6	8.1	4.6	5.3
Drinks	.0	.2	1.8	.0	.5
Total On-Farm	**82.0**	**85.9**	**93.2**	**90.6**	**87.8**
Off-Farm					
Cash Payments From Off-Farm	16.1	11.6	5.3	7.9	10.2
In-Kind Payments From Off-Farm	2.0	.3	.2	.3	.7
Remittances	.0	2.3	1.3	1.2	1.2
Total Off-Farm	**18.1**	**14.2**	**6.8**	**9.4**	**12.1**
Cash Payments To Labor	-.2	-.1	.0	.0	-.1
in-Kind Payments To Labor	-.3	-1.8	-3.4	-1.9	-1.6
TOTAL NET INCOME (MT)	**280,044**	**269,398**	**310,599**	**448,902**	

[1] Based on Cultivated Land Only

Source: Nampula Smallholder Survey

Table 10. Household Income Shares By Adult Equivalent Land Area Quartile; Angoche

Income Source	Adult Equivalent Land Area Quartile[1]				District Average
	1	2	3	4	
	------ % of Gross Household Income ------				
On-Farm					
Staple Food Retained For Consumption	44.7	34.6	38.6	32.5	37.3
Food Sales	22.5	21.9	21.3	27.4	23.4
Cotton Sales	.0	.0	.0	.0	.0
Cashew Sales	8.5	18.8	14.9	12.2	13.7
Livestock Sales	1.1	1.1	.6	.7	.9
Livestock Slaughter	1.6	2.1	1.1	1.3	1.5
Other Ag Sales	7.2	6.1	7.4	6.6	6.8
Drinks	.0	.0	.2	.1	.1
Total On-Farm	**85.6**	**84.6**	**84.1**	**80.8**	**83.7**
Off-Farm					
Cash Payments From Off-Farm	14.0	14.9	15.1	18.8	15.8
In-Kind Payments From Off-Farm	.4	.5	.2	.1	.3
Remittances	.0	.0	.6	.2	.2
Total Off-Farm	**11.8**	**14**	**14.9**	**17**	**14.5**
Cash Payments To Labor	-1.7	-1.1	-.5	-1.4	-1.2
In-Kind Payments To Labor	-.9	-.3	-.5	-.7	-.6
TOTAL NET INCOME (MT)	**245,945**	**450,773**	**298,274**	**532,908**	

[1] Based on Cultivated Land Only

Source: Nampula Smallholder Survey

In Angoche there appears to be no relationship between farm size and off-farm income share. This appears puzzling in light of the apparently greater land pressure in this district (as reflected by much smaller farm size). But households in all land area quartiles in this district have off-farm shares that are relatively high for this sample. Shares in the upper two quartiles in Angoche are the highest of any district. Too, due to the security problems mentioned earlier,surveyed villages in Angoche present fewer opportunities for off-farm earnings than, for example, villages in Monapo, where the cotton estate and factory account for most hired labor.

Third, cash cropping of cotton and cashew is an important source of income in Monapo and Angoche, but plays almost no role in Ribaué. While absolute cash crop earnings in Monapo and Angoche increase with land area, their share of total income shows no clear relationship to farm size. Fourth, livestock play a minuscule role in income strategies, and this does not change by region or by farm size within region. As noted above, this situation may be largely attributable to the rural banditry to which so many villagers have been subjected over the years.

Finally, remittances are virtually non-existent. Northern Mozambique has never had the tradition of migratory labor of the south, where South African mines are more easily reached. Ribaué previously provided labor to the tea plantations in Zambezia, but this has largely ended (Martins). The unrest has undoubtedly made it more difficult to move back and forth or otherwise send remittances to families.

Taken together, the results presented in the last two sections present a picture of extreme vulnerability for many rural households. First, land access may be constrained for some households in each district, but especially in Angoche (Tables 2 and 4). Second, opportunities for off-farm earnings, which take on great importance in the face of land constraints, are very limited. Third, livestock holding, which traditionally plays an important savings and insurance role in rural Africa, is a very risky activity which many households have decided not to undertake or to do so in reduced scale. And finally, the very low proportions of households who purchase food suggest that, for whatever reason, food markets appear to be playing little role in assuring the food security of rural households.[10]

Expenditure Patterns

Given this situation, what do smallholders spend their cash income on? Table 11 shows mean household cash expenditure shares by district and season. Expenditures during the harvest season account for between 67% and 77% of yearly expenditures. This high share is to be expected in a situation where agriculture accounts for most cash income, where savings mechanisms are poorly developed, and where market failure increases the uncertainty associated with food purchases later in the year[11].

[10] See See MOA/MSU/UA Research Team, 1992a and 1992b for more information on the structure of the rural marketing system.

[11] Banks, of course, are practically unknown. But traditional savings mechanisms such as livestock holding are more constrained in Mozambique than they might be elsewhere. There are also increased risks associated with holding cash or crops for later sale.

Table 11. Household Cash Expenditure Shares By District and Season 1991

	Monapo			Ribaue			Angoche		
	Harvest	Hungry	Entire Year	Harvest	Hungry	Entire Year	Harvest	Hungry	Entire Year
	% of Cash Expenditure								
Food									
Staples	7.3	11.9	8.5	4.9	7.8	5.3	1.9	2.3	1.8
Fish	26.7	42.3	29.5	11.7	27.1	12.7	32.4	44.7	36.0
Other Food	11.7	12.1	11.7	7.8	10.8	8.3	10.3	11.2	10.6
Total Food	45.7	66.3	49.6	24.5	45.7	26.2	44.6	58.1	48.4
Consumer Goods									
Kerosene	7.6	12.7	8.4	1.7	4.9	2.0	14.6	20.8	15.8
Soap	10.3	16.6	10.8	21.0	43.6	23.6	7.3	9.4	7.9
Clothing	32.1	4.0	27.6	35.5	3.7	32.6	26.7	7.6	21.7
Other Consumer Goods	1.0	.4	.9	.3	.0	.3	1.8	1.8	1.8
Total Consumer Goods	**50.9**	**33.7**	**47.7**	**58.5**	**52.2**	**58.5**	**50.4**	**39.6**	**47.3**
Services									
Health and Education	.6	.0	.5	9.5	2.1	8.6	3.5	2.3	3.3
Taxes	2.7	.0	2.2	6.0	.0	5.4	1.6	.0	1.1
Transport	.1	.1	.2	1.7	1.7	2.8	.0	.0	.0
Total Services	**3.5**	**0.1**	**2.9**	**17.1**	**3.8**	**16.8**	**5.1**	**2.3**	**4.3**
Share by Season	75.6%	24.4%	100.0%	76.6%	23.4%	100.0%	67.6%	32.4%	100.0%

Source: MOA/MSU/UA Food Security Project Household Data.

What is surprising is that food takes up nearly 50% of all cash purchases in Monapo and Angoche. This figure seems rather high in light of the previous evidence showing very low proportions of net food (staple) buyers. The seeming paradox is explained by the dominance of fish expenditures within the food group. These account for 59% of food expenditures in Monapo, 48% in Ribaué, and 74% in Angoche. Staple purchases, which were the only food purchases analyzed in the section on market participation status, do not account for more than 20% of food purchases in any district, and they reach less than 4% in Angoche. Staple purchases are important for those who make them. For these households (16% of the sample), such purchases represented 48% of all cash expenditures on food.

Calorie Sources

Consumption shares across all three districts are strongly dominated by retained own production of staples (Table 12). In no district does this item average less than a 95% share of total household calories. In light of the significant share of food in total cash expenditures, this result presents another apparent paradox to be explained.

Table 13 presents information on the cost per calorie consumed, by source of acquisition. The key result is that purchased food, driven largely by dried fish, is between 29 and 70 times more expensive than the value of retained own production.[12] Another key result is that the difference between purchased staple prices and prices received by farmers is very large. For example, maize meal when purchased costs between two and three times more than the weighted average price of staples sold. Purchased rice in Angoche and Monapo exceeds by four and eight times, respectively, the value of the food basket sold in each district.

Table 12. Household Consumption Shares by District

Source of Calories	Monapo	Ribaue	Angoche
	------- % of Total Calorie Availability ------		
Consumed own production	95	98	95
Purchased	5	2	5
Staples (% of purchased)	24	14	4
Fish (% of purchased)	48	60	66
Other (% of purchased)	28	26	30
Received In-Kind	1	0	0

Source: Nampula Smallholder Survey

[12] Retained own production of stapes is valued at the sale price for that household, if it sold some of the product, or at the mean sale price for that product in that district, if the household did not sell.

Two conclusions follow from this analysis. First, the failure of rural food markets for purchases is extreme. Poor infrastructure, many years of tightly controlled commercial activity, slow response to recent policy liberalization, and continuing risk of attack have all contributed to this situation. Second, households use food purchases not as an important source of calories, but as a source of variation in their diet. Of the 51% of households responding that the typical hungry season meal "was not sufficient to maintain the health of (your) family", 46% gave as a reason not insufficient quantity *per se*, but "lack of variation in the diet". Fish, especially, provides protein, but perhaps more importantly, provides a strong flavor to contrast with the very bland staples of boiled maize or manioc meal.

THE DETERMINANTS OF HOUSEHOLD INCOME AND CONSUMPTION LEVELS

There are a large number of factors that interact in many complex ways to determine the level of wellbeing attained by a given household. The complexity of this process is such that any two households of apparently similar endowments might enjoy fairly different levels of wellbeing. Too, the relative importance of different factors, and their relationship to each other, can change over time and across geographic regions.

Table 13. Cost per Calorie by Source

Source Of Calories	Monapo	Ribaue	Angoche
		---------- Meticais/Calorie ----------	
Retained Staples[1]	.04	.05	.05
Purchased Food	2.79	1.38	1.87
Maize Meal	.10	.11	.09
Dried Fish	3.61	1.57	2.03
Rice	.33	.07	.19
Other	.08	.30	.04

[1] Weighted average cost calculated from sales prices.

Source: Nampula Smallholder Survey

Nevertheless, it is apparent that certain identifiable factors can, in general, be expected to have important effects on wellbeing, though each may not do so in every case. Also, reasonable hypotheses can be formed regarding the principal means by which these factors exert their influence within the household. In attempting to determine which factors are most important, it is thus necessary to identify the general set of factors which are expected to exert some influence, and to clearly delineate the logical relationships between these factors and the various dimensions of wellbeing. This is done schematically in Figure 1. The pertinent dimension of wellbeing in the figure is consumption, broken down by food and non-food. The figure distinguishes between two types of factors. Those outside the control of the household ("exogenous" factors) which influence its

resource allocation decisions are denoted by dark boxes. Other factors, such as food production and expenditure patterns, are under the control of the family, but are influenced by the exogenous factors. These "endogenous" factors are denoted by light boxes.

The three sets of exogenous factors which condition household decisions are: 1) household assets and structure, 2) the input and output prices and wage rates it faces, and 3) the institutional (including policy) and physical (including available technology) setting in which it operates. Household assets may affect resource allocation decisions in a number of ways. For example, it is an empirical regularity in Sub-Saharan Africa that households with larger land holdings are more likely to grow cash crops (Jayne; other references). Under conditions of general land scarcity, those households with the most constrained access to land have often been shown to be more likely to diversify into non-agricultural income generating activities (Walker and Ryan; Liedholm and Kilby).[13]

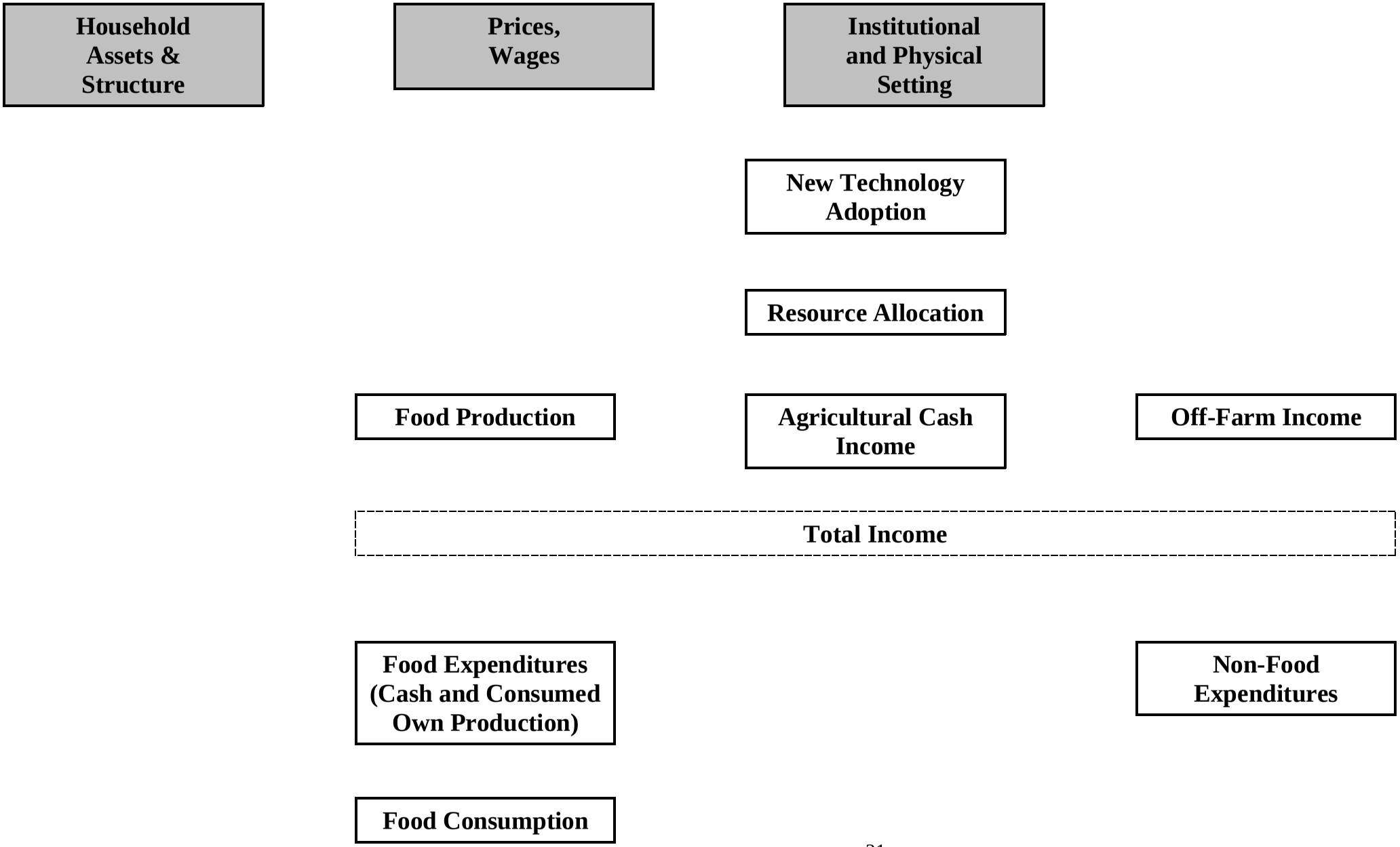
Relative prices between farm and and non-farm activities drive household behavior as members allocate their time at the margin to the most profitable activity. For a given level of output prices, higher (lower) wage rates should result in a relatively greater (lesser) share of income deriving from off-farm activities (see Goetz; also Reardon et al.)

The institutional and physical setting in which a household finds itself can have enormous impacts on the range of resource allocation options open to it. Especially important, in terms of the decision to participate in product markets, is the impact of market information and marketing infrastructure on the transactions costs the household must bear to participate in the market. While markets might "exist" in the sense of some households engaging in sales and/or purchases of food, these markets might selectively fail for certain households due to the high cost of participation (Goetz; de Janvry, et al.). Off-farm opportunities will be affected by the general level of development in the area and by the ease of remitting to the household earnings from employment obtained through migration.

These exogenous variables will then affect the choices made by the farm family, including the decision of whether or not to adopt available technologies, and how to allocate time and financial resources both within and beyond the farm. These decisions then affect the absolute and relative levels of the three components of income, to wit, food production, cash income from agricultural sales, and cash income from off-farm labor. The levels and relative shares of these three components influence the share of total expenditure (both cash purchases and own production) going to food and non-food, which in turn determines the level of food consumption of the household.

[13] Other studies show inconclusive results on this issue. See Reardon, et al. and Taylor

Figure 1. Conceptual Framework for Analyzing the Determinants of Income and Consumption Among Mozambican Smallholders



The Model

This section presents the results of an econometric model that estimates the contribution of each of these three income components to household calorie consumption per adult equivalent. More generally, the model attempts to identify those factors which exert most influence over the level of income and consumption of a household, and to quantify the effects of each.

In combination with the preceding tabular analysis, econometric techniques can provide a more solid basis for conclusions, primarily because they allow one to better isolate the impacts of individual variables. For example, the following analysis will allow us to answer questions such as "what will tend to happen to the income and energy availability of a household if, without changing total area cultivated or any other important factors, the household takes land out of food crops and puts it into cotton?". We could also answer questions such as "what tends to happen to the amount of energy available per person in a household when an additional infant (or adult) enters that household, again without changing total area cultivated or other important variables?". The model will be used to address these and other important questions, with the purpose of improving the body of knowledge on which to base policy.

A key question influencing the specification of the model is whether the resource allocation decisions that determine energy production, off-farm income, and income from agricultural sales are separable from the consumption decision (implying a recursive model; see Strauss), or whether these decisions are simultaneous. The answer to this question depends on the set of markets in which farm households operate, and on the transaction costs and risks associated with participation in each market. If all factor, product, and labor markets exist, if transaction costs of participation are not prohibitive, and if risk is minimal, then the decisions can be regarded as separable. For example, a smallholder could decide to plant less area without reducing consumption, having the option of working off the farm and then buying food with those earnings. If, on the other hand, product, factor or labor markets are very thin (implying high risk), or if market information and infrastructure are so poor as to make participation for many households prohibitively expensive, then a decision, for example, to dedicate most of one's land to cotton for sale has obvious implications for the level of consumption that family will be able to attain.

This is clearly the case in Mozambique. Table 6 demonstrates the thinness of product markets. Factor markets (for example for fertilizer) are virtually non-existent, and labor markets are also very thin and seasonal. Thus, the model is a set of four equations estimated with a two-stage least squares technique. In the first stage, equations are estimated for each of the three income components (calories produced, income from cash crop sales, and income from off-farm, all per AE). In the second stage, estimated values of these variables, along with relevant exogenous variables, are used in the final equation explaining energy availability (also per AE). Wages and agricultural product prices are not included, for two reasons. First, producer prices show little variation around government mandated minimum prices. Second, institutional aspects of the labor market, in addition to its thinness, make it very difficult to determine a meaningful wage rate.[14] Estimating the model separately for each district reflects the hypothesis that differing agroecological and demographic conditions in each lead to distinct functional relationships between the variables. The equations are:

$$KPROD = f(ASSETS, STRUC, COTAREA) \quad (1)$$

[14] Hired workers on farms are paid by area worked, rather than by day. But the survey collected earnings per day, resulting in extreme variability in daily earnings (since area worked per day varied greatly). Thus, the daily wage rates calculated are largely meaningless.

$$INCACO = f(ASSETS, STRUC, COTPEST, COTPEST^2) \quad (2)$$

$$INCOFF = f(ASSETS, STRUC, COTAREA) \quad (3)$$

$$KAVAL=f(KPROD^*, INCOFF^*, INCCACO^*, STRUC, VVFEMPCT) \quad (4)$$

where,

* denotes an estimated rather than actual value,

KPROD is net household food production (total production minus in-kind payments to hired labor) during this harvest year expressed in kilocalories/AE/day,

INCCACO is net household cash income per AE from sales of cotton and cashew (value of sales minus cash payments to hired labor),

INCOFF is household off-farm cash income per AE (cash income from full or part-time off-farm work plus remittances)

KAVAL is net energy available to the household during this harvest year, calculated according to the disappearance method and expressed as kilocalories/AE/day,

ASSETS is a vector of household asset variables:

TOTAREA is cultivated area per AE during this harvest year, minus area in pure stands of cashew &/or coconut,

CASHEW is the number of cashew and coconut trees tended to per AE during this harvest year (cashew trees dominate coconut trees in all districts, so that this variable primarily measures the impact of cashew holdings),

LVST is the value of livestock holdings per AE during this harvest year,

OUTMIG is a dummy variable for the presence of a family member living off the farm and sending remittances

FAL-CUL is fallow area as a percentage of TOTAREA in this harvest year,

STRUC is a vector of household structure variables:

DEP-RAT is the household dependency ratio, defined as the number of children under ten and elderly above 65 resident in the household as a percentage of the total number of household members,

NADULT is the number of non-elderly adults resident in the family (10-65 years, inclusive),

AGEHHH is the age of the head of household,

EDHHH is a dummy variable indicating whether the head of household is literate (1) or not (0),

POLYG is a dummy variable indicating whether the head of household is polygynous (1) or not (0),

FEMHEAD is a dummy variable indicating whether the household is headed by a woman (1) or not (0),

COTAREA is area planted to cotton during this harvest year as a percentage of total area cultivated,

COTPEST is an interaction term between proportion of land allocated to cotton (COTAREA) and pesticide usage per hectare of cotton land, [15] and

VVFEMPCT is the proportion of total income from agricultural sales which is controlled by the woman.

Discussion of Results

Model results are presented in Table 14.

Energy Production (KPROD)

In each district, total area cultivated per adult equivalent (TOTAREA) is the principal predictor of energy production. The coefficients on TOTAREA are statistically significant, large, and positive as expected. The marginal productivity (in terms of calories) of an acre of land is highest in Angoche, the most land constrained district, and lowest in Ribaué, the district with largest household land holdings.

The coefficient for the dependency ratio (DEP_RAT) is negative as expected in all districts, and is also statistically significant in each case. On average, an additional child brought into the household decreases energy production per AE per day by 245 calories in Monapo, 389 calories in Ribaue, and 462 calories in Angoche. These reductions represent 7.3%, 14.1%, and 19.1%, respectively, of mean calorie availability in each district, and would be especially damaging to the large number of households already consuming below 80% of energy requirements.

[15] Cotton is highly susceptible to attack by insects. Thus, it is hypothesized that it is not cotton area alone that will affect total income from agricultural sales, but rather the combination of cotton area and use of pesticides on that area. Thus, this interaction variable is used in the INCCACO equation in place of separate variables for cotton area and pesticide use.

Table 14. Regression Results on Determinants of Income and Consumption

	KAVAL			INCCACO			INCOFF			KPROD		
	Mon	Rib	Ang	Mon	Rib	Ang	Mon	Rib	Ang	Mon	Rib	Ang
KPROD*	.695	.578	.354	---	---	---	---	---	---	---	---	---
	(.000)	(.000)	(.096)									
INCOFF*	-.004	-.021	-.005	---	---	---	---	---	---	---	---	---
	(.436)	(.624)	(.819)									
INCCACO*	-.000	-.065	.001	---	---	---	---	---	---	---	---	---
	(.978)	(.196)	(.435)									
VVFEMPCT	-11.7	-2.0	1.495	---	---	---	---	---	---	---	---	---
	(.336)	(.888)	(.943)									
POLYG	749.0	-155.0	76.8	6173.2	4040.0	8788.5	47999.8	-3303.2	-10289.5	-233.3	1763.3	-38.2
	(.140)	(.715)	(.851)	(.519)	(.110)	(.616)	(.004)	(.652)	(.515)	(.771)	(.031)	(.963)
FEMHEAD	372.7	-143.6	1743.2	-6529.6	-1582.4	-33390.4	-3116.0	-12392.9	-28681.4	-2615.1	-715.5	2049.0
	(.761)	(.889)	(.452)	(.607)	(.642)	(.195)	(.883)	(.285)	(.217)	(.015)	(.572)	(.088)
DEP_RAT	-6.9	-6.1	-12.0	-212.2	-7.6	164.9	188.2	173.4	82.0	-20.4	-38.9	-35.5
	(.221)	(.526)	(.232)	(.111)	(.856)	(.537)	(.388)	(.174)	(.733)	(.064)	(.007)	(.005)
AGEHHH	-15.3	11.5	-2.2	-530.7	-21.9	-298.6	-225.4	5.1	-96.3	-34.4	19.6	-.8
	(.073)	(.356)	(.873)	(.033)	(.720)	(.506)	(.591)	(.979)	(.812)	(.104)	(.358)	(.970)
NADULT	-164.5	-81.9	-172.9	-4750.9	-633.9	2326.5	2917.6	276.3	-1378.4	-80.1	-451.8	-324.5
	(.120)	(.549)	(.082)	(.099)	(.339)	(.608)	(.537)	(.898)	(.736)	(.735)	(.059)	(.125)
EDHHH	-208.3	-99.1	-22.2	-11475.4	-2880.3	-24966.9	11318.8	-6374.6	6182.7	-861.8	1036.8	439.0
	(.397)	(.810)	(.925)	(.079)	(.144)	(.029)	(.298)	(.293)	(.546)	(.115)	(.121)	(.405)
TOTAREA	---	---	---	17776.6	583.7	-2904.2	9492.8	-3216.8	78340.4	4104.6	2723.5	6449.2
				(.059)	(.741)	(.880)	(.531)	(.586)	(.000)	(.000)	(.000)	(.000)
COTAREA	---	---	---	---	---	---	-267.0	-311.4	---	-14.7	10.7	---
							(.240)	(.231)		(.196)	(.706)	
COTPEST	---	---	---	.122	.288	---	---	---	---	---	---	---
				(.000)	(.488)							
COTPEST2	---	---	---	$-4.705x10^{-08}$	4.7x10E.07	---	---	---	---	---	---	---
				(.000)	(.924)							
CASHEW	---	---	---	812.9	1776.8	3617.7	27.9	1742.7	-56.7	61.1	-31.6	4.0
				(.000)	(.016)	(.000)	(.915)	(.474)	(.756)	(.000)	(.906)	(.671)
LVST	---	---	---	.075	-.027	.234	.891	-.032	-.131	-.006	-.013	.003
				(.652)	(.574)	(.594)	(.002)	(.841)	(.739)	(.645)	(.456)	(.878)
OUTMIG	---	---	---	5407.7	770.2	4908.4	30586.2	-2447.1	-9491.6	1683.6	-1281.7	-3148.1
				(.606)	(.732)	(.875)	(.081)	(.738)	(.736)	(.056)	(.114)	(.031)
FAL_CUL	---	---	---	-5.4	-2.0	-184.3	39.1	-15.7	110.2	-1.5	.997	3.8
				(.897)	(.884)	(.047)	(.577)	(.732)	(.185)	(.669)	(.843)	(.375)
Constant	2294.8	862.6	1995.8	49167.0	4674.1	-834.3	-2699.5	9739.2	-1929.7	4098.0	3404.5	3154.2
	(.001)	(.465)	(.015)	(.003)	(.336)	(.975)	(.920)	(.498)	(.935)	(.003)	(.034)	(.011)
Adj. R^2	.822	.552	.551	.477	.188	.746	.221	-.090	.136	.587	.368	.480

[1] Numbers in parentheses are significance levels, calculated from adjusted standard errors
Source: Nampula Smallholder Survey

The coefficient on the number of non-elderly adults (NADULT) in the household is negative in every case, but is statistically significant only in Ribaue (it is nearly significant in Angoche). This is a strong result, since the model specification holds land area cultivated per AE constant, implying an increase in actual land cultivated with the entrance of another adult. Even so, energy production per AE does not appear to keep pace.

Finally, the proportion of land in cotton (COTAREA) has a negative but statistically insignificant effect on the household's energy production per AE in Monapo. This too is an important result, since it is obtained while holding constant the total amount of land cultivated per AE. This suggests that, on average across the sample, households may not be giving up any food production by pulling some land out of food crops and planting it to cotton. This conclusion is supported by the observation that cotton producers obtain 28% more calories per hectare planted to food crops than do non-cotton growers. The precise reasons for this difference require further study.

Unexpectedly, the coefficient for polygamy (POLYG) was positive and statistically significant in Ribaué, indicating that polygamous households tend to produce more calories per AE than otherwise similar monogamous households in this district. The hypothesized effect was negative, due to the reduced presence of the male head and thus less availability of labor. POLYG was not statistically significant in the other two districts.

Female headed households (FEMHEAD) are associated with significantly lower levels of calorie production in Monapo, while in Angoche the opposite holds. There appears to be no significant effect of female headedness in Ribaué.

Off-Farm Income (INCOFF)

Cash earnings off the farm are the most difficult of the income components to explain. Results in Ribaue show no statistically significant coefficients and a negative adjusted R^2. In Monapo, polygyny, livestock holdings, and the presence of an outmigrant are significantly and positively associated with off-farm income. In Angoche, cultivated area per AE is positive and highly significant, indicating that households with more land tend to earn more money off the farm.

It is worth noting that cotton area as a proportion of total area has a negative coefficient in Monapo and Ribaué, though it is not statistically significant in either district. Combined with the labor intensity of cotton relative to food crops, this result suggests the possibility that cotton production may compete with off-farm work as an income source.

Income From Cash Crop Sales (INCCACO)

As expected, the coefficient on cultivated area per AE (TOTAREA) is large and significantly positive in Monapo, largely reflecting the contribution of cotton. This coefficient is not significant in either Ribaué or Angoche. In Ribaué, this is a reflection of the very poor performance of cotton in the district, while the lack of cotton cultivation in Angoche explains this result in that district.

The number of cashew and coconut trees is statistically significant and positive in all three district. This result is somewhat surprising in Ribaué, given the poor performance of cashew in that district, and the small proportion of total income accounted for by cashew sales. This latter result was due to the very small number of trees harvested by most households in this district. Nevertheless, the results indicate that, for those able to harvest in Ribaué, each cashew tree represents an important source of income. In fact, the marginal value of a single tree in Ribaué is double that in Monapo. Thus, effective management of the pest problem affecting cashew trees in Ribaué could make a very

important contribution to household income in this district. The marginal value of a tree in Angoche is more than double that in Ribaué, and more than four times that in Monapo.

Both the linear and quadratic terms on the cotton area-pesticide use interaction variable (COTPEST) are significant and of the expected sign in Monapo. This is a key result, indicating that cotton production, when combined with the use of pesticides, contributes significantly to cash income from agricultural sales. At mean levels of cotton area and pesticide use (41% of total area, and 6,970 MT/ha, respectively), results indicate that cotton growers have an income advantage from cash crop sales of 30,471 MT/AE over non-cotton growers of otherwise similar characteristics. This is equal to 23% of mean household income per AE from all sources in Monapo.

Neither cotton interaction term is statistically significant in Ribaué, reflecting the very poor yields obtained in this District. These in turn are reflective of the extremely low level of pesticide use. Of the 25 cotton producers in this district, 18 (72%) used no pesticides at all.

Finally, household head literacy had a negative coefficient in all three districts, and was statistically significant at α=.10 or lower in Monapo and Angoche. This result is puzzling, suggesting that more educated farmers are less likely to obtain income from cotton and cashew than are less educated farmers.

Calorie Availability (KAVAL)

Coefficients on calorie production (KPROD) are large, positive, and significant in every district. Thus, calorie availability per adult equivalent is largely determined by on-farm calorie production in all three districts. The marginal propensity to consume out of own energy production is highest in Monapo, as could have been expected due to the dominant roles of cotton and cashew as sources of cash income in this district (meaning that food crops are sold in small proportions). In contrast, in Angoche, where the share of income from food sales (primarily peanuts and rice) is far higher than in the other two districts, much less is consumed out of own production.

Cash income, either off farm (INCOFF) or from cash crop sales (INCCACO), has no statistically discernable effect on consumption. This result is in line with the earlier tabular analysis showing very low consumption shares from purchased food, and highlighting the extreme failure of rural food markets for purchases.

The number of non-elderly adults in the family (NADULT) has a negative coefficient in all three districts, being statistically significant Angoche and nearly so in Monapo. The addition of an adult to the family in these districts reduces average energy availability by 164 to 173 calories/AE/day. This is a significant amount in light of the number of households which already appear to be at serious nutritional risk. It also provides evidence to question the commonly held view that land is abundant across all households in the smallholder sector in Mozambique.

As expected, the dependency ratio (DEP_RAT) has a negative coefficient in all three districts, though it is not statistically significant at α=.10 or better in any of the districts.

The percentage of agricultural cash income controlled by the woman (VVFEMPCT) does not appear to effect final calorie availability in any district. Under a system of well functioning rural food markets, the expected impact of this variable would have been positive, under the hypothesis that women are more likely to spend additional income on food. Given the widespread failure of rural food markets observed in Mozambique, the lack of statistical significance of this variable is not surprising.

Summary of Key Model Results

In each zone, land area cultivated is far and away the principal determinant of energy production and income from agricultural sales, and thereby of total income. Energy production is then the primary determinant of overall energy availability, thus establishing the key role of land holdings in household welfare. This result differs from that in many other African settings where markets, especially for off-farm labor, are more developed. In these cases, access to some, even small, amount of land is often critical in determining income, but the actual amount of land is often not highly correlated with either income or consumption outcomes, since land poor households can obtain income through off farm work and use it to purchase food (Von Braun and Pandya-Lorch; see also Lipton, pp. 5-8).

The negative impact of an additional adult laborer on both calorie production and final calorie availability per AE is striking in light of the widespread belief that land is abundant and labor is the constraining resource in the smallholder sector. This issue of the relative scarcity of land versus labor will be looked at more closely below.

The predominant position of calorie production in final availability, and specifically the lack of any statistically discernable effect of cash earnings on energy availability, also differs from findings in many other African countries. The scarcity of off-farm employment opportunities, and the widespread failure of food markets for purchases for many families appears to have pushed most toward a marked reliance on own production to ensure food security.

The record on cash crops is, on balance, positive. Cashew production contributes very significantly to cash income from agricultural sales in all three districts (though the absolute size of this contribution is important only in Monapo and Angoche, due to the small number of trees harvested in Ribaué). Furthermore, there is no discernable competition between it and off-farm work.

Cotton production, when combined with pesticide use, also has significantly positive impacts on cash income from agricultural sales in Monapo. The lack of similar effects in Ribaué can be attributed at least in part to the very low rate of pesticide use there. The possibility that cotton production competes with off-farm income earning opportunities cannot be neglected, but is of less concern given the current paucity of such opportunities. Expansion of any opportunity for earning additional income, whether on or off the farm, must be judged in a positive light.

A CLOSER LOOK AT LAND ACCESS

The failure of food, labor, and input markets for so many households in rural Mozambique, and the resulting predominance of land holdings in determining a household's income and consumption, imply the need for a closer examination of the issue of land abundance and access in the Mozambican smallholder sector.

It is widely believed that land is abundant in Mozambique, and that labor is the principal constraint to production in the smallholder sector. Any land scarcity which may exist is generally assumed to be caused by the war. The logical conclusion is then that the problem will disappear when the war ends.[16] In fact, this appears to be the attitude of smallholders themselves. When asked whether, in

[16] There are relatively recent exceptions to this mode of thinking. See especially Carrilho, et. al (1990) and Martins (1992b); and volume 5 and the special June 1992 volume of Extra, which deal

their opinion, there would be sufficient land for everyone when the war ended, 92%, 95%, and 70% responded affirmatively in Monapo, Ribaué, and Angoche, respectively.

The belief in land abundance is also based upon the relatively low population densities for the country as a whole when compared to other African countries. While Mozambique's density is nearly double that in Zambia, it is less than one-third of Malawi's, and is slightly lower than those in Tanzania and Zimbabwe. But these data hide geographical variation that can cause densities to vary greatly within a country. In Mozambique, population densities in Nampula are among the highest in the country, and coastal densities are higher than those in the interior. A focus only on population densities also ignores land quality, which must be considered in determining what a sustainable population density might be for a given area.

More importantly, such a focus sheds no light whatsoever on those factors that determine whether land is, in practice, abundant for a given family. These factors are institutional and social in nature, and in practice they always result in some inequality of land ownership. Given this, the appropriate question becomes not whether land is "abundant" in some purely physical sense, but whether existing institutional and social structures are such that all households have access to at least the minimum amount of land they need to ensure their wellbeing. The more precise term of land access must replace that of abundance.[17]

A number of important policy conclusions follow from the lack of focus on the concept of land access and the attendant view that land is abundant for smallholders. One implicit conclusion is that little policy attention needs to be directed toward ensuring sufficient access to land for all smallholders, since existing systems (a combination of traditional and more recent official arrangements) either already do so, or would do so in the absence of the war. A specific conclusion is that divestiture of state farms need not necessarily be oriented to ensure priority access to smallholders. Another key conclusion may be that land saving inputs such as fertilizer, pesticides, and irrigation, will be relatively less socially profitable than labor saving inputs such as increased animal traction or mechanization.

Results in this paper begin to cast doubt on the assumption of unconstrained land access for all households with sufficient labor, and on the policy conclusions that follow from this. First, land holdings per AE vary by a factor of approximately six in each district between the smallest 25% and largest 25% of farms (Table 2). Second, the most land poor households in each district are at serious nutritional risk. Within the smallest cultivated land per AE quartiles, only 22% to 36% of households achieve 80% of calorie requirements (Table 4). Third, the number of adults in a household tends to have a negative impact on energy production and final energy availability per AE (regression results from Table 14). This would not be expected in a situation of land abundance, as the arrival of an additional laborer would enable the opening of sufficient new land to at least maintain per AE consumption levels. The similarity of these results across three very different districts is striking.

Table 15 presents more information relevant to the issue of land access. A number of important points stand out. First, households in the smallest quartiles are no more likely to have abandoned land than those in the larger quartiles. Furthermore, the rural violence is not the primary reason for

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extensively with a wide range of issues related to land.

[17] Again, others in Mozambique have dealt with the problem of land access, and the need to take measures to improve it for all smallholders (not just "deslocados"), even in the seemingly "land abundant" setting of Mozambique. See Carrilho and Martins (1992b).

abandoning land for the majority of those who have done so, and those who did abandon for security reasons are not concentrated in the lowest quartiles. Too, families officially registered as displaced ("deslocados") due to the war are not concentrated in the lower quartiles. Thus, survey evidence does not support the assertion that land abandonment due to the war is the primary reason for the existence of large numbers of land poor households. There would appear to be other factors at work preventing access to sufficient land for some households.

Second, between 38% and 51% of families across the three districts have no fallow. This result is puzzling in light of the importance of fallow in traditional agriculture, and the widespread assumption of land abundance. Third, the ratio of household labor to cultivated land varies across a wide range in each district. If labor were the principal constraint to expanded farm size, one would not expect to find this pattern. Thus, this result also appears to be at odds with the assumption of land abundance in the smallholder sector.

Fourth, female headedness, considered broadly to include both overt female headed households and polygamous households, does not appear to be associated systematically with lower land holdings in Monapo and Ribaue. These households are spread throughout the quartiles in these two districts.[18] The evidence is mixed in Angoche. Here, female headed households are also spread throughout the land area quartiles, but polygamous households are sharply concentrated in the lower half of the land holding distribution.[19]

A further test of the hypothesis of land abundance is possible based on the logical observation that, if land is abundant and labor is the only constraining factor, then the arrival of an additional laborer will have a neutral effect on cultivated land per AE. The following regression equation implements this test:

[18] Polygamous households were distinguished from overtly female headed households in the survey, even though the male may be present only half the time or less in a polygamous household. Nevertheless, it is felt that they can be usefully considered together in contrasting the situation of households where a male head is continually resident with those (female headed and polygamous) where he is not.

[19] Note that wives of polygamous males in Nampula do not farm any communal land. Each has their own separate home and their own fields. Thus, all land worked by a polygamous household can be safely ascribed to that household without the risk of double counting.

Table 15. Household Land and Labor Characteristics Per Household Adult Equivalent Land Quartile: By District

District and Adult Equivalent Land Area Quartile (Cultivated Land)	Mean Farm Size Ha. Cultivated Per adult Eq.	Mean Farm Size Total Ha. Cultivated	% HH with Fallow Fields	% HH With Abandoned Lands	% Abandoning for Security Reasons (of all hh's)	Mean Age Of HH Head Years	% HH Female Headed	% HH Officially Displaced (Deslocados)	% HH Polygamous	Mean HH Size # people	Mean # Adults Per Hectare Cultivated
MONAPO	.56	1.6	49	42	18	41	8	5	8	4.06	2.04
Quart. 1 .11-.30 ha	.20	.8	48	25	10	39	12	8	5	4.76	3.66
Quart. 2 .30-.44 ha	.36	1.3	51	47	27	42	10	0	16	4.49	2.16
Quart. 3 .46-.75 ha	.60	1.8	29	49	20	41	0	12	6	3.93	1.41
Quart. 4 .75-2.33 ha	1.09	2.5	71	49	16	42	10	0	7	2.96	0.94
RIBAUE	.69	2.4	62	40	16	40	7	5	17	5.1	1.76
Quart. 1 .07-.35 ha	.26	1.2	38	41	4	38	8	9	21	5.96	3.61
Quart. 2 .36-.59 ha	.50	2.1	66	25	9	40	11	7	11	5.41	1.70
Quart. 3 .60-.89 ha	.74	3.0	79	45	22	38	0	0	17	5.43	1.09
Quart. 4 .90-4.00 ha	1.27	3.4	64	48	30	43	9	4	18	3.54	0.72
ANGOCHE	.39	1.1	60	56	17	42	5	9	10	4.2	3.56
Quart. 1 .07-.20 ha	.14	.6	43	49	18	44	3	4	20	6.07	6.28
Quart. 2 .20-.29 ha	.24	.7	70	62	21	38	0	5	12	3.90	3.99
Quart. 3 .29-.46 ha	.36	1.0	62	48	14	40	7	20	3	3.56	2.66
Quart. 4 .49-1.84 ha	.82	1.9	67	66	16	48	8	5	5	3.12	1.40

Source: Nampula Smallholder Survey.

CULTAE = f(LAND, STRUC, VILL), (5)

where,

CULTAE = cultivated land per AE,

LAND = a series of variables on land use and access,

ABANAE = the number of hectares the household has abandoned in the past,
COTTON = a dummy variable indicating whether the household does (1) or does not (0) grow cotton,
AREA2PCT = the percent of total cultivated area that the household obtained through the traditional tenure system,
NATIVE = a dummy variable indicating whether a household has (1) or has not (0) always resided in this area,

STRUC = a series of household structure variables hypothesized to affect land area,

DEP-RAT = the household dependency ratio, defined as the number of children under ten and elderly above 65 resident in the household as a percentage of the total number of household members

NADULT = the number of non-elderly adults resident in the family (10-65 years, inclusive)

AGEHHH = the age of the head of household

AGEHHH2 = the squared age of the head of household

EDHHH = a dummy variable indicating whether the head of household is literate (1) or not (0)

POLYG = a dummy variable indicating whether the head of household is polygynous (1) or not (0), and

VILL = a series of village dummy variables

The model is run separately for each district, due to significant differences in demographic and land holding patterns. If land holdings are constrained only by labor availability, then an additional laborer should have no effect on cultivated land per AE. This would be reflected by a statistically insignificant coefficient on NADULT. A negative and statistically significant coefficient on this variable would lead to the conclusion that factors other than labor availability are constraining land access for many households.

Model results are presented in Table 16. The coefficient of NADULT is negative and statistically significant in every district, leading to a rejection of the hypothesis of unconstrained land access for all families with sufficient labor. An additional laborer reduces cultivated land per AE, on average, by 15% in Monapo, 22% in Ribaué, and 17% in Angoche.[20]

[20] Percentages were calculated using mean per AE land cultivation from Table 2.

Summarizing the results so far presented regarding land access, we have found that:

1. Household land/labor and land/AE ratios vary greatly in each district (Tables 2 and 15),

2. Household land holdings do not keep pace with additional laborers (results from equation 5),

3. Intensification of land use does not appear to make up the difference in most cases (equation 1), with the result that final energy availability per AE is reduced by additional laborers (equation 4),

4. Increased land holdings have a highly positive impact on energy availability (equations 4 and 1),

5. The most land poor households appear to be at serious nutritional risk (Table 4), and

6. Land abandonment due to the war does not appear to be the sole or even the primary reason for very low land holdings by many households (Table 15).

Clearly, then, factors other than labor availability are constraining land access for many households. The challenge which remains is to identify these factors. Two possibilities suggest themselves. First, the land tenure system could be granting access to households based on factors other than, or at least additional to, actual need. Second, the war may constrain land access, not through land abandonment, but by preventing households from expanding their land holdings as their families grow.

Separating the effects of these two factors is difficult, since they can lead to similar results. For example, each might cause households in need of additional land for cultivation to bring fallow into production rather than opening new land. This would result in a smaller percentage of households with fallow land than would otherwise be observed. It was noted earlier that surprisingly large percentages of households do not have fallow. Also, if a household has no fallow, either of these factors might cause it to not expand cultivated area as the family grew, or to expand less than it would like, resulting in lower land/ae ratios.

Thus, survey data will not support the analysis needed to resolve the issue of which factor, an inequitable land tenure system or the war, is most responsible for the current land distribution. But the data will allow some steps in this direction. First, it seems reasonable to ask whether the war alone, by constraining land expansion for growing households, could lead to the range of land holdings per adult equivalent observed in this data. Recall that the ratio of mean land cultivated per adult equivalent in the smallest compared to the largest land area quartiles was approximately between five and six in each district. This means that, in each district, the 25% of households which could be considered land rich had approximately five or six times more land per "mouth to feed" (AE) than the 25% of households considered land poor. It would appear unreasonable to these authors to expect this kind of difference due solely to the war, but further research is needed before a firm conclusion can be reached.

Table 16. Regression Results on Determinants of Land Area Cultivated per AE, by District

Independent Variable	Districts		
	Monapo	**Ribaue**	**Angoche**
CONSTANT	.770	1.173	.721
	(.055)	(.002)	(.008)
AREA2PCT	5.882	-.002	2.051
	(.946)	(.045)	(.784)
DEP_RAT	-.004	-.001	-.004
	(.007)	(.464)	(.001)
AGEHHH	-.014	-.003	-.014
	(.367)	(.874)	(.250)
AGE2HHH	1.896	6.807	2.001
	(.270)	(.720)	(.126)
NADULT	-.086	-.150	-.065
	(.026)	(.000)	(.004)
ABAN_AE	.210	.358	.173
	(.015)	(.001)	(.009)
NATIVE	.238	-.021	.065
	(.065)	(.848)	(.229)
POLYG	.049	-.087	-.089
	(.710)	(.405)	(.302)
FEMHEAD	-.007	-.264	.172
	(.968)	(.090)	(.145)
COTTON	.259	.493	-.115
	(.006)	(.000)	(.532)
VILL2	.137	.098	.037
	(.231)	(.438)	(.634)
VILL3	-.132	-.006	.175
	(.266)	(.961)	(.030)
VILL4	-.230	-.098	-.021
	(.053)	(.561)	(.783)
VILL5	.206	-.114	.128
	(.130)	(.390)	(.112)
Adj. R^2	.274	.368	.365

1 Numbers in parentheses are significance levels

Source: Nampula Smallholder Survey

A final comment relates to the way in which the war, as compared to an inequitable land tenure system, would lead to inequality of land holdings. It was noted above that the war could constrain growing families from opening as much new land as they would like. Thus, one would expect families that have grown in size since the onset of the war to have smaller land holdings per AE than families that have not grown, or that have grown less. Furthermore, one would expect all families in an insecure area to be affected in more or less equal measure by the war. If the war is the only factor leading to inequality, then a logical conclusion is that households in the same geographical area, of similar size (measured by number of AE), and with household heads of similar age would be expected to have similar land holdings per AE. Large variability <u>across</u> area/age/size categories could be consistent with the hypothesis that the war is the only cause of inequality. But a great deal of inequality <u>within</u> a given category would make it less plausible that the war alone had lead to the observed pattern.

Table 17 presents the number of households from Ribaué district which fall into each land area quartile, broken down by age/size category. It shows that, in the great majority of cases, households

Table 17: Distribution of Households of Similar Age and Size Across Adult Equivalent Land Area Quartiles, Ribaue

AGE OF HEAD, NO. OF AE	LAND AREA QUARTILE				TOTAL
	1	2	3	4	
	---------- # OF HOUSEHOLDS ----------				
Up To 30 Yrs					
Less Than 1.5 AE	0	1	0	0	1
1.6-2.0 AE	2	1	0	1	4
2.1-2.5 AE	1	0	0	2	3
2.6-3.0 AE	1	4	4	1	10
3.1-3.5 AE	0	0	0	2	2
3.6-4.0 AE	1	0	2	1	4
4.1-4.5 AE	2	0	0	0	2
More Than 4.5 AE	0	3	4	0	7
31-40 Yrs					
Less Than 1.5 AE	0	0	0	0	0
1.6-2.0 AE	1	0	0	1	2
2.1-2.5 AE	0	0	0	1	1
2.6-3.0 AE	0	1	1	2	4
3.1-3.5 AE	0	0	0	0	0
3.6-4.0 AE	2	3	2	2	9
4.1-4.5 AE	2	1	3	1	7
More Than 4.5 AE	6	3	1	0	10
41-50 Yrs					
Less Than 1.5 AE	0	0	0	1	1
1.6-2.0 AE	0	0	0	1	1
2.1-2.5 AE	0	2	0	1	3
2.6-3.0 AE	0	0	1	1	2
3.1-3.5 AE	0	0	0	1	1
3.6-4.0 AE	1	2	2	1	6
4.1-4.5 AE	0	0	1	0	1
More Than 4.5 AE	4	3	2	1	10
51-60 Yrs					
Less Than 1.5 AE	0	0	0	0	0
1.6-2.0 AE	0	0	0	0	0
2.1-2.5 AE	0	0	0	2	2
2.6-3.0 AE	1	0	0	1	2
3.1-3.5 AE	0	0	0	0	0
3.6-4.0 AE	0	1	0	0	1
4.1-4.5 AE	0	0	0	0	0
More Than 4.5 AE	3	2	3	1	9

Source: Nampula Smallholder Survey

within a given category are distributed across at least two and often three or four quartiles.[21] In other words, even among households of similar size and with household heads of similar age, some households have as much as five or six times more land per adult equivalent than others. Results from Monapo and Angoche are very similar to those from Ribaué, and therefore are not presented.

These results suggest that other factors in addition to the war are likely contributing to the situation of constrained land access for many households. Identifying these factors, and establishing their importance relative to the war, must await further research.

CONCLUSIONS, POLICY IMPLICATIONS, AND FURTHER RESEARCH

The results presented in this paper are based on a survey of 343 rural smallholders in the relatively secure areas of Ribaué, Monapo, and Angoche districts in Nampula province. The sample is believed to be broadly representative of those smallholders in each district which have been less directly affected by the war. Thus, study results likely reflect the situation of the relatively better off portion of the rural population in these districts. The survey covered household structure, purchase and sale of labor, land areas and cropping patterns, production, sales, livestock holdings and flows, input use, expenditures and consumption (24 hour recall), as well as questions regarding farmer perceptions of their situation.

Key results indicate that incomes are low and variable in each district, and highly correlated with land holdings. Calorie consumption is also low and quite variable, with many families in each district not achieving even 80% of caloric requirements. Calorie consumption, like income, was also found to be strongly dependent on land holdings. Relatively land rich households nearly all reach at least 80% of caloric requirements, while most land poor households do not.

The central role of land holdings in determining incomes and consumption is largely a result of serious market failure in the surveyed districts. Food market participation rates, and especially the proportion of net buyers (those buying more food than they sell) are lower than those found in most other SSA research. Purchased food comprises a very small proportion of total caloric intake (approximately 5% on average), and is much more expensive than the value of retained own production. Off-farm income represents, on average, only 15% of total income in the three districts, very low by SSA standards. Faced with limited off-farm income earning opportunities, and with food for purchase often unavailable and quite expensive when it is, surveyed smallholders have adopted a strategy of marked reliance on farm based own production to ensure their survival. This in turn makes their income and consumption highly dependent on the amount of land they have to cultivate. Very low yields in comparison with other Southern African countries compound the problem.

[21] The precise numbers in each cell are not as important as the spread of households across quartiles. If households in a given age/size category are frequently spread across three or more quartiles, this is considered by the authors as more inequality than could be plausibly expected if the war were the only factor at work.

The question of land access then becomes crucial. Survey evidence indicates clearly that many households are constrained in their access to land, and that labor availability and land abandonment due to the war do not appear to be the principal causes. Other possibilities include constrained land expansion (as opposed to land abandonment) due to the war, and an inequitable land tenure system. Survey evidence is not sufficient to clearly distinguish the relative importance of these two factors, but the paper suggested that it is implausible to ascribe all the observed inequality to the war. While more research is needed, the authors believe that the issue of land access for all smallholders, not just *deslocados*, deserves serious attention from policy makers.

It was found that cash cropping of cashew contributes significantly to income in Monapo and Angoche. Cashew would likely play a much more positive income role in Ribaué were it not for the recent emergence there of a serious disease problem. Cotton production in Monapo contributes quite significantly to income from agricultural sales, but may compete with off-farm income earning opportunities. Importantly, cotton production, even controlling for land size and other relevant variables, does not appear to compromise a household's production and consumption of calories. This implies that, if rural food markets for purchase could be improved, the increased cash earnings from cotton could contribute to improving these households' caloric intake.

Smallholders and policy makers in Mozambique are thus faced with a set of interrelated problems. Very low yields from existing technologies, in combination with an inequitable land distribution pattern, mean that food must be available for purchase if many households are to meet their consumption needs. But in a market setting, this food will not be made available without sufficient effective demand. And this demand will not emerge unless smallholders can generate increased cash incomes through off-farm work or greater sales of cash or food crops.

Cotton growing enterprises offer one way out of this quandary. By generating significant amounts of cash income in relatively small geographical areas (through both cotton sales and work in cotton processing facilities), such enterprises might provide the base of effective demand needed for the emergence of stronger markets for food purchases. This will in turn make it possible for land poor farmers to use the increased income earning opportunities offered by cash cropping to improve their consumption.

Such a scenario requires that returns to land and labor from cash cropping be significantly above those from food cropping. This in turn depends on many institutional aspects of the enterprise and its relationship to government and local smallholders.[22] Given the emergence of several new cotton enterprises in Nampula and other provinces in recent years, careful attention to the organization of these enterprises and to the relative roles of the private firm, local smallholders, and local, provincial, and national government could pay very high dividends. Focused research on these issues, spanning a number of different enterprises, is greatly needed. Insights from such research may also be of use in designing policy for the production and marketing of cashew. Finally, Mozambique has a long history of tobacco and tea production, both of which could also benefit from the lessons learned in cotton.

As the rural marketing system develops over time, and especially as food and labor markets improve, the dominance of land holdings in determining household income and consumption will decrease. But land holdings will remain very important for the welfare of most rural households for the

[22] See Lele, et al. for a review of cotton experience in Sub-Saharan Africa, and a good discussion of the relative importance of pricing factors relative to institutional or organizational factors in determining the level of benefits accruing to participating smallholders.

foreseeable future. Thus, improving the technological and management packages available to smallholders to increase food and cash crop yields is of key importance. Further household level research on land access in the smallholder sector should also be accorded high priority. Such research should emphasize sorting out the relative importance of the war versus long term structural factors in leading to the current unequal distribution of land within the smallholder sector, and should identify specific means to improve smallholder land access. The similarity of results across all the villages studied in three quite different districts suggests that at least in Nampula province, rather systematic factors are leading to differential land access in the smallholder sector. To confirm this, and to investigate the situation in other provinces, detailed household level data on land access is needed from other districts of Nampula, and from other provinces. Such data should be complemented by more detailed attention to the organization of the existing land tenure system than was accorded by the current study.

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