Food Security Strategies Under Extremely Adverse Conditions: The Determinants of Household Income and Consumption in Rural Mozambique

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Summary. — This paper uses household survey data from war-torn northern Mozambique to examine the factors associated with higher incomes and improved rural household food security. Incomes and calorie consumption were found to be low and variable in each district, and both are highly correlated with land holdings. The central role of land holdings is largely a result of serious market failure. Food market participation rates and the proportion of net buyers are lower than in other sub-Saharan Africa (SSA) research. Purchased food as a percentage of total caloric intake and off-farm income as a percentage of total income are both very low by SSA standards. In short, surveyed smallholders have adopted a strategy of marked reliance on farm-based own production to ensure their survival. It is suggested that land holdings will continue to be key determinants of household income and consumption for the foreseeable future. Broad-based rural development efforts, possibly organized around existing cotton-growing enterprises, may offer one way out of the poverty trap for smallholders.

1. INTRODUCTION AND OBJECTIVES

Following 10 years of negative growth associated with a highly centralized economic system and an expanding civil war, 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 reversed 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.[1] Key objectives in the agricultural sector included increasing smallholder production and marketed surplus of food, and reintegrating 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.* (1988) argue, the diversity of smallholder economic behavior makes it imperative that food security and structural adjustment policies be deeply rooted in such empirical

knowledge. Such knowledge is especially important in Mozambique, where the civil war that began in the late 1970s has devastated large areas of the country, disrupting economic activity and displacing millions of people from their homes.

Previous research on the economic behavior of smallholders in sub-Saharan Africa (SSA) has not

often been conducted under such adverse social and economic conditions. Yet Mozambique is not unique; as of mid 1993, Angola, Chad, Ethiopia, Liberia, Somalia, the Sudan, and Zaire also suffered from ongoing problems of rural violence. Moreover, for perhaps the majority of smallholders in Mozambique, 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. Under these circumstances, how might smallholder income and food security strategies differ from those found in so many other settings? Might the factors associated with higher incomes and improved rural household food security in Mozambique be different from those in other SSA countries? If so, what implications will this have for development policy and for the expected effects of the structural adjustment effort on smallholder welfare and overall agricultural sector performance?

This paper utilizes data from a survey of 343 smallholders in northern Mozambique to begin answering some of these questions. Specifically, the paper has 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. The paper proceeds as follows: (a) relevant recent literature is briefly reviewed, (b) the study setting and methods are described, (c) general income and consumption patterns in the study area are presented, (d) smallholder income and food security strategies are discussed, (e) an econometric model of the determinants of household income and consumption is presented, (f) results from the model are discussed, and (g) conclusion and recommendations are presented.

2. INSIGHTS FROM OTHER SUB-SAHARAN AFRICA RESEARCH

Over the past decade, a large body of literature has helped to dispel the myth of the autarkic African smallholder. This literature has shown not only that the large majority of smallholders participate in rural food markets, but that significant numbers of them are net buyers of food. Complementary research has shown that smallholder integration into the market economy extends beyond food to cash crop markets and agricultural and nonagricultural labor and other factors markets. Staatz, D'Agostino and Sundberg (1990) show in Mali that this market integration is greatest in areas of lowest agricultural potential, and that it is associated with levels of household food security at least as great as those in areas of high potential but less diversified economic activity.

Reardon, Delgado and Matlon (1992) show similar results in Burkina Faso.[2]

This increasingly accepted view of African smallholders operating within a system of agricultural and nonagricultural factor and product markets has led more recently to an examination of the impact on the opportunity set of the household when one or more markets within this system are missing or imperfect. De Janvry, Fafchamps and Sadoulet (1991) demonstrate analytically how missing food or labor markets lead to "external stability" in the form of diminished cash crop price responsiveness by smallholders, even while "internal instability" increases as reflected by highly variable perceived scarcities of food and labor. Fafchamps's (1992) analytical model shows that when food markets are present but not well integrated over space, price volatility and high covariance of prices with household production limit the extent to which smallholders will adopt a more commercially oriented income and food security strategy. Finally, Jayne (1994) uses survey data from Zimbabwe to explain similar behavior, not with price risk, but with policy induced market imperfections that increase the wedge between the very stable prices of maize for sale and maize meal for purchase.

Where smallholders have adopted a more commercial orientation, most research shows a highly positive income effect (von Braun, Puetz and Webb, 1989; von Braun, de Haen and Blanken, 1991; von Braun and Pandya-Lorch, 1991; Kennedy, 1989; Kennedy and Cogill, 1987). These same studies generally show a statistically significant positive impact of income on calorie consumption, though the size varies from Kennedy's "weak" link in Kenya (an income elasticity of demand for calories of 0.15) to the much higher elasticity of 0.50 found by von Braun, de Haen and Blanken in Rwanda (1991).[3]

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 appear to be strongly associated with increased income and significantly but less strongly associated with improved household food security. The rest of this paper will examine the extent to which this pattern holds true in Mozambique.

3. 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 settle-

ment patterns observed in the province. Population densities are highest in Angoche, followed by Monapo and finally Ribaué. Rainfall is similar in all three district, but soil quality improves as one moves from the coastal fringe into the interior.

Ribaué, with the best combination of water and soil resources, had historically been the strongest agricultural area of the three. Events of the past 10 years have changed this situation, however. First, this district has been affected for a longer period by the civil war, whose impacts on physical infrastructure have therefore been more severe. Second, the collapse of a government cotton production and marketing para-statal (*Secretaría do Estado de Algodão*) has led to extremely poor cotton production in recent years. Finally, a disease problem has devastated cashew production in recent years. In contrast, both Monapo and Angoche have been somewhat less affected by the war, and have benefited from much stronger institutional support, especially for cash crop production and marketing.

It is important to note that surveyed villages were randomly selected in each district only from the set of villages deemed safe by local officials. Thus, survey results reflect the situation of those households that have been relatively less affected by the war. 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 in a peacetime setting.[4] 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. It is commonly assumed, 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.

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.

(a) Agricultural production characteristics

Nampula province, and Zambezia province just to the south, have historically been 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. Cassava is grown by nearly all households in all three surveyed districts. Other important food crops in the interior (Ribaué) are beans, maize and sorghum. Maize and sorghum are less important on the coast (Angoche), where rice and peanuts play a greater role.

Food crop yields appear low compared with other Southern African countries. Typical intercrop maize yields among surveyed households during 1991 ranged between 250 and 800 kg/hectare. CIMMYT quotes average intercrop maize yields of between 830 and 3,000 kg/hectare among low input smallholders in the Southern African region (Low and Washington, 1990). These low yields are related to very low input use. No surveyed smallholder reported using pesticides or fertilizer on their food crops, and nearly all used unimproved local seeds. 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. During the colonial era, cotton was produced with forced labor on the fields of Portuguese producers, and through coerced cultivation on smallholders' own plots. Production dropped dramatically following independence, but has begun to rebound in recent years, as major new cotton-growing enterprises have been initiated in collaboration with foreign agribusiness firms. One such enterprise has located in Monapo. Over half of smallholders surveyed in this district cultivate the crop 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. Yields there averaged only 11% of those in Monapo, due primarily to very low levels of pesticide use. 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. Combined government/private sector support for cashew marketing is stronger than for any crop other than cotton. 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 the previously mentioned disease problem has reduced to five the average number of trees harvested per household.

(b) Land holdings

The issue of land distribution has taken an increasingly important place in Mozambique's national debate in recent years.[5] Despite this, there are few if

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any comprehensive studies of land access conditions in the smallholder sector. A study based on preindependence data suggested that land concentration in the Mozambican smallholder sector (as measured by Gini coefficients) was similar to that found in the smallholder sectors of Malawi, Ivory Coast, and Nigeria (Ghai and Radwan, 1983, p. 11). More recent studies, based on secondary data, report average smallholder land holdings ranging from 1.5 ha (Bruce, 1989) to between 2.0 and 2.5 ha (World Bank, 1989). These studies do not address the important issue of land distribution within the sector.

Data from this survey begin to shed some light on this issue. Table 1 breaks sampled households into land area quartiles, based on three different definitions of land assets: cultivated plus fallow land per household, cultivated plus fallow land per household consumption adult equivalent (AE), and cultivated plus fallow land per household laborer. Quartiles are recalculated for each measure of land holding utilized.

Based on its population density, Mozambique is typically viewed as a land abundant country.[6] In this setting, smallholder land holdings per household would be expected to vary in accordance with household size. Those with more mouths to feed would need more land, and therefore would obtain it, subject to labor availability (Binswanger and McIntire, 1987). Thus, land holdings per AE and per laborer would be expected to be far less variable across households. But results in Table 2 show this not to be the case. In fact, in every district, the share of all land held by the largest 25% of smallholders rises, while the share held

by the smallest 25% falls, when land is measured per household AE or per household laborer as opposed to per household. Thus, contrary to expectations, land concentration appears to increase when measured in AE or labor terms. The spread in smallholder land holdings also appears greater than might be expected under conditions of land abundance. In each district, mean holdings in the largest quartile are six to seven times greater than those in the smallest quartile.

(c) The civil war

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, most coming in response to an open question at the end of the interview. 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% 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.[7]

Despite the war, 60% of respondents indicated that

Table 1. *Household land holdings (cultivated and fallow) by Surveyed Districts of Nampula Province, 1991*

District/ land area quartile*	Per household		Per household adult equivalent		Per household laborer†	
	Ha	% of area held	Ha	% of area held	Ha	% of area held
Monapo	2.14	100	0.77	100	0.94	100
Quart. 1	0.73	9	0.25	8	0.30	7
Quart. 2	1.53	18	0.50	16	0.62	18
Quart. 3	2.19	26	0.75	24	0.95	27
Quart. 4	4.14	48	1.60	51	1.87	48
Ribaué	3.49	100	1.00	100	1.27	100
Quart. 1	1.20	9	0.30	7	0.37	7
Quart. 2	2.72	19	0.69	18	0.80	16
Quart. 3	4.02	30	1.09	27	1.36	27
Quart. 4	6.12	42	1.96	48	2.58	50
Angoche	1.51	100	0.54	100	0.66	100
Quart. 1	0.59	10	0.17	8	0.20	7
Quart. 2	0.98	14	0.33	15	0.39	16
Quart. 3	1.49	27	0.50	24	0.56	21
Quart. 4	2.90	48	1.15	53	1.48	56

Source: Nampula Smallholder Survey.
*Quartiles vary by the measure of land area utilized.
†Any resident family member ages 10–65, inclusive.

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Table 2. *Household welfare indicators by district and adult equivalent income quartile*

| District | Adult equivalent income quartile | | | | |
	1	2	3	4	Sample average
Monapo					
Net income/AE (mt)	40,869	85,692	134,485	267,148	131,642
Kcal/AE/day	1,754	3,060	3,569	5,197	3,390
% HHs reaching 80% of calorie requirements	33	87	83	84	72
Cult. Ha per HH AE	0.33	0.50	0.61	0.80	0.56
Ribaué					
Net income/AE (mt)	29,941	57,004	89,195	183,848	89,188
Kcal/AE/Day	1,528	2,464	2,794	4,403	2,785
% HHs reaching 80% of calorie requirements	22	71	71	92	64
Cult. Ha per HH AE	0.50	0.56	0.65	1.05	0.69
Angoche					
Net income/AE (mt)	36,886	70,744	126,074	328,635	140,600
Kcal/AE/Day	1,224	1,581	2,991	4,248	2,515
% HHs reaching 80% of calorie requirements	10	20	74	92	49
Cult. Ha per HH AE	0.26	0.36	0.34	0.60	0.39

Source: Nampula Smallholder Survey.

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 and for a longer period, 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.

4. OVERVIEW OF INCOME AND CONSUMPTION PATTERNS

Household incomes are very low in all three districts (Table 2).[8] Average incomes per adult equivalent are lowest in Ribaué (less than US$45) where land holdings are largest, and highest in Angoche (slightly more than US$70) where land holdings are smallest. Nevertheless, incomes within each district are strongly and positively associated with land holdings.

Calorie availability is also quite variable and, within each district, is highly associated with both land holdings and income per AE.[9] Across districts, this relationship between land holdings and calorie availability is less strong, as shown by average availability in Monapo exceeding, and in Angoche almost equalling, 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 Ribaué and finally Angoche. In the latter,

over half of all households appear to be seriously compromised.

5. SMALLHOLDER INCOME AND FOOD SECURITY STRATEGIES

(a) *Food crop market participation*

Households were categorized according to whether they only bought, both bought and sold, only sold, or neither bought nor sold a basket of the six staples (maize, cassava, beans, sorghum, rice, and peanuts; see Table 3). Large majorities in each district participated in the food market, though most did so only as sellers. In fact, less than 12% purchased any amount of these foods in Ribaué and Angoche, while just over 26% made any purchases in Monapo. Net buyers were even fewer, representing 19.5% in Monapo, 6.7% in Ribaué, and only 3.2% in Angoche.[10]

Table 3. *Household market participation status based on a basket of six food crops, by district[a]*

Market participation status	Monapo	Ribaué	Angoche
	% of households sampled		
Only bought	9.9	5.3	3.2
Both bought and sold	16.2	6.4	4.4
Only sold	46.0	61.2	85.0
Did not participate	27.9	27.0	7.4

Source: Nampula Smallholder Survey.
[a]Basket is comprised of maize, cassava, beans, rice, peanuts, and sorghum.

The survey finding of very low levels of food purchases is bolstered by data from a market information system (AMIAS) which has monitored weekly supplies and prices of staple foods in the principal markets of each district since May 1991. In Ribaué, the foods monitored by AMIAS were either in short supply or unavailable in the principal market at least 75% of the time. In Monapo, all products except white maize meal were unavailable or in short supply at least 60% of the time, while in Angoche, only cassava was available in normal or large quantities more than 50% of the time. Supplies in smaller markets are believed to be even less reliable.

These results show surveyed districts of Nampula province to have a generally higher proportion of food market nonparticipants and a lower proportion of net food buyers than in other SSA countries. Weber *et al*'s (1988) review of work in Mali, Senegal, Somalia, Rwanda, and Zimbabwe, found nonparticipation rates that varied between 0% and 40% for individual food crops. Mali, Somalia, and Rwanda all had rates below 15%. The proportion of nonparticipants in Mozambique increases significantly when calculated on a crop-by-crop basis. As a point of comparison, 60% and 49% of all households did not participate in the maize market in Monapo and Ribaué, respectively, between 24% and 81% across the three districts did not participate in the cassava market, and 37% did not participate in the rice market in Angoche. Weber *et al.* (1988) report net buyer rates for individual crops of

between 25% and 73%. In Mozambique, no more than 26% buy any food crop in the three districts, and not all of these are net buyers. Thus, the proportion of net food buyers is unambiguously lower in surveyed areas of Mozambique.

(b) *Income sources*

How do earnings from food crop sales fit into the overall income and food security strategies of the households? Specifically, how diversified are smallholder incomes in Mozambique, both within and beyond agriculture, compared with those in other SSA countries? Tables 4–6 present household income shares for each district by quartile of income per adult equivalent. On-farm income is that coming from crop or animal production. Off-farm income includes cash and in-kind income from off-farm labor, earnings from non-agricultural activities (e.g., weaving), and remittances.

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% in three zones of Burkina Faso (Reardon, Delgado and Matlon, 1992), 29%–55% in two zones of Mali (Staatz, D'Agostino and Sundberg, 1990), and 62% by Kennedy and Cogill (1987) in southwestern Kenya. Von Braun, Puetz and Webb (1989) in the Gambia most closely

Table 4. *Household income shares by adult equivalent income quartile: Monapo*

Income source	Adult equivalent income quartile				District average
	1	2	3	4	
	% of gross household income				
On-farm					
Staple food	50.5	44.7	37.0	27.7	40.0
Retained for consumption					
Food sales	7.1	4.3	5.8	6.3	5.9
Cotton sales	23.6	22.6	25.1	10.1	20.4
Cashew sales	4.2	8.3	15.1	12.0	9.9
Livestock sales	1.7	0.7	0.4	3.7	1.6
Livestock slaughter	2.2	2.2	1.3	1.5	1.8
Other ag sales	0.4	1.7	3.3	11.1	4.1
Drinks	0.2	—	0.1	—	0.1
Total on-farm	89.9	84.4	88.1	72.4	83.8
Off-farm					
Cash payments from off-farm	9.8	15.3	11.7	26.6	15.8
In-kind payments from off-farm	0.3	0.2	0.1	0.1	0.1
Remittances	—	—	0.2	0.9	0.3
Total off-farm	10.1	15.5	12.0	27.6	16.2
Cash payments to labor	−0.1	−0.2	−0.3	−1.5	−0.5
In-kind payments to labor	−1.2	−0.1	−0.7	−1.0	−0.8
Net income per AE (MT)	40,869	85,692	134,485	267,148	131,642

Source: Nampula Smallholder Survey.

Table 5. *Household income shares by adult equivalent income quartile: Ribaué*

Income source	Adult equivalent income quartile				District average
	1	2	3	4	
	% of gross household income				
On-farm					
Staple food	76.8	72.1	53.1	52.4	63.7
Retained for consumption					
Food sales	9.6	11.3	11.9	14.7	11.9
Cotton sales	1.2	2.2	0.5	1.3	1.3
Cashew sales	—	—	0.8	0.3	0.3
Livestock sales	0.3	1.6	1.8	3.2	1.7
Livestock slaughter	1.9	3.0	3.1	5.1	3.2
Other ag sales	2.8	2.8	8.6	6.8	5.2
Drinks	1.1	0.8	—	—	0.5
Total on-farm	93.7	93.8	79.7	83.8	87.8
Off-farm					
Cash payments from off-farm	2.4	4.2	19.7	14.8	10.2
In-kind payments from off-farm	1.9	0.5	0.3	0.2	0.7
Remittances	2.0	1.5	0.2	1.2	1.2
Total off-farm	6.3	6.2	20.2	16.2	12.1
Cash payments to labor	−0.3	—	−0.1	−0.1	−0.1
In-kind payments to labor	−2.1	−3.4	−0.4	−0.5	−1.6
Net income per AE (MT)	29,941	57,004	89,195	183,848	89,188

Source: Nampula Smallholder Survey.

Table 6. *Household income shares by adult equivalent income quartile: Angoche*

Income source	Adult equivalent income quartile				District average
	1	2	3	4	
	% of gross household income				
On-farm					
Staple food retained for consumption	48.4	39.1	32.9	28.8	37.3
Food sales	22.3	31.4	19.2	21.0	23.4
Cotton sales	—	—	—	—	—
Cashew sales	11.7	9.6	24.1	23.4	17.3
Livestock sales	0.8	0.9	0.8	1.1	0.9
Livestock slaughter	1.4	1.2	2.7	0.7	1.5
Other ag sales	4.3	4.3	1.8	3.1	3.3
Drinks	—	0.2	0.1	—	0.1
Total on-farm	88.8	86.7	81.5	78.0	83.7
Off-farm					
Cash payments from off-farm	10.2	13.0	18.3	21.7	15.8
In-kind payments from off-farm	0.4	0.3	0.2	0.1	0.3
Remittances	0.7	—	—	0.2	0.2
Total off-farm	11.3	13.3	18.5	22.0	16.3
Cash payments to labor	−1.3	−0.6	−1.6	−1.1	−1.2
In-kind payments to labor	−0.7	−0.5	−0.5	−0.6	−0.6
Net income per AE (MT)	36,886	70,744	126,074	328,635	140,600

Source: Nampula Smallholder Survey.

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approached these results, finding that 77% of total income was generated on smallholders' farms. In a more comprehensive but less current review, Haggblade, Hazel and Brown (1989) did not find on-farm shares as high as 85% in any of 10 SSA countries. They reached this conclusion despite using data primarily from the 1960s and early 1970s, when agriculture was presumably less commercialized than it is now in most countries.

Second, diversification outside of own-farm activities appears to be positively associated with income in all three districts. In Angoche, the off-farm share rises steadily with income, while in Ribaué the two highest quartiles show off-farm shares nearly three times those in the lowest two quartiles. In Monapo, there is no association between income and diversification until the highest quartile, where the off-farm share approximately doubles.

Third, cash cropping is an important income source in both Monapo and Angoche. Cashew sales are important in both districts, and appear in each to be positively associated with total income. Cotton is quite important in Monapo, with a mean income share of over 20%. Interestingly, a trade-off between cotton production and off-farm earnings emerges in the highest income quartile in this district. At this level, a sharp drop in cotton's share is made up entirely by off-farm earnings.

Fourth, livestock play a minuscule role in income strategies in all three districts. As noted above, aside from animal health problems this may be largely attributable to the rural banditry to which so many villagers have been subjected over the years.

Finally, remittances are virtually nonexistent. Northern Mozambique has never had the tradition of migratory labor of the south, where South African mines are more easily reached. Opportunities that did exist have been diminished by the combined effects of government economic policies and the war.

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 1 and 2). 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. 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.[11]

(c) Cash expenditure patterns

Surprisingly, food takes up nearly 50% of all cash purchases in Monapo and Angoche (Table 7). This figure seems rather high in light of the previous evidence showing very low proportions of net staple food 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.

Table 7. *Household cash expenditure shares by district and season 1991*

	Monapo	Ribaué	Angoche
Food			
Staples	8.5	5.3	1.8
Fish	29.5	12.7	36.0
Other food	11.7	8.3	10.6
Total food	49.6	26.2	48.4
Consumer goods			
Kerosene	8.4	2.0	15.8
Soap	10.8	23.6	7.9
Clothing	27.6	32.6	21.7
Other consumer goods	0.9	0.3	1.8
Total consumer goods	47.7	58.5	47.3
Services			
Health and education	0.5	8.6	3.3
Taxes	2.2	5.4	1.1
Transport	0.2	2.8	—
Total services	2.9	16.8	4.3

Source: Nampula Smallholder Survey.

(d) Calorie sources

Consumption shares across all three districts are dominated by retained own production of staples. 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. Analysis showing the cost per calorie consumed by source of acquisition begins to do this (Table 8). One key result is that purchased food, driven largely by dried fish, is 29–70 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.

Two conclusions follow. First, the failure of rural food markets for purchases is extreme. Poor infrastructure, continuing risk of attack, many years of tightly controlled commercial activity, and slow private sector response to recent policy liberalization have all contributed to this situation. Second, households apparently 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 as importantly, provides a strong flavor to complement the bland staples of boiled maize or manioc meal.

6. THE DETERMINANTS OF HOUSEHOLD INCOME AND CONSUMPTION LEVELS

(a) The model

This section presents an econometric model designed to examine more carefully the relationships between households' chosen food security strategies and their calorie consumption outcome. Specifically, the four equation model first investigates the determinants of three principal inputs to a household's consumption function: food production, income from cash crop sales, and off-farm cash income including remittances. It then estimates the impact of each of these inputs, along with other predetermined variables, on household calorie consumption.[13] Following Bouis and Haddad (1990), right-hand side variables are tested for endogeneity in each equation using a Hausman test. Where exogeneity is rejected, an estimated rather than actual value for that variable is used.[14] The equations are:

$$KPROD = f(ASSETS, STRUC, COTAREA) \quad (1)$$
$$CASHCROP = f(ASSETS, STRUC, COTPEST) \quad (2)$$
$$INCOFF = f(ASSETS, STRUC, COTAREA) \quad (3)$$
$$KAVAL = f(KPROD, INCOFF, INCCACO, STRUC, VVFEMPCT) \quad (4)$$

where,

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

CASHCROP is net household cash income per AE from sales of cotton and all cashew products (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 and/or coconut,

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

Table 8. *Cost per calorie by source*

Source of calories	Monapo	Ribaué	Angoche
		Meticais/Calorie	
Retained staples*	0.04	0.05	0.05
Purchased food	2.79	1.38	1.87
Maize meal	0.10	0.11	0.09
Dried fish	3.61	1.57	2.03
Rice	0.33	0.07	0.19
Other	0.08	0.30	0.04

Source: Nampula Smallholder Survey.
*Weighted average cost calculated from sales prices.

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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 10 and elderly above 65 resident in the household as a percentage of the total number of household members,

NADULT is the number of nonelderly adults resident in the family (10–65 years, inclusive),

AGEHHH is the age of the head of household,

EDHHH is a dichotomous variable indicating whether the head of household is literate,

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

FEMHEAD is a dichotomous 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.

Results are presented in Table 9.

(b) *Summary of key model results*

In each zone, land area cultivated is far and away the principal determinant of calorie production, and has positive or neutral effects on off-farm income and cash crop income. Calorie production is then the primary determinant of overall calorie 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 purchase food with income obtained through off-farm work (Von Braun and Pandya-Lorch, 1991; see also Lipton, 1985, pp. 5–8).

Off-farm income has a positive but small effect on final calorie availability in Angoche. On average in this district, a 1% increase in off-farm income will increase final calorie availability by only 0.037%.

Off-farm income has no statistically discernible effect on calorie availability in the other two districts. Cash cropping income has no influence on calorie availability in Monapo or Angoche, but appears to have a small negative impact in Ribaué. In general, it can be stated that cash income, whether from cash cropping or from off-farm work, has little effect on a household's consumption position. Own-calorie production dominates.

The number of nonelderly adults (NADULT) in the household has a negative effect on calorie production (KPROD) in every case, and is statistically significant in Ribaué. This despite holding land area cultivated per AE constant, implying an increase in total land cultivated by the household with the entrance of another adult. Even so, energy production per AE does not appear to keep pace. NADULT also has a negative effect on final calorie availability (KAVAL) in all three districts, and is statistically significant in Monapo. The addition of an adult to the family in this district reduces average energy availability by 170 calories/AE/day. This is a significant amount in light of the number of households which already appear to be at serious nutritional risk. These results are unexpected in light of the widespread belief that land is abundant and labor is the constraining resource in the smallholder sector.

The predominant position of calorie production in final availability, and the generally weak influence 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 crop income 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), shows no discernible competition with off-farm work, and is positively associated with calorie production in Angoche. Cotton production, when combined with pesticide use, also has significantly positive impacts on cash crop income in Monapo and even Ribaué, though the effects in the latter are quite small. Cotton production does not appear to compete with food production. It does appear, however, to compete with off-farm income earning opportunities in both districts.

7. CONCLUSIONS, POLICY IMPLICATIONS, AND FURTHER RESEARCH

The results presented in this paper are based on a survey of rural smallholders in the relatively secure

Table 9. Regression results on determinants of income and consumption*

	KAVAL			CASHCROP			INCOFF			KPROD		
	Mon	Rib	Ang	Mon	Rib	Ang	Mon	Rib	Ang	Mon	Rib	Ang
KPROD	0.630 (0.000)	0.657 (0.000)	0.659 (0.000)	—	—	—	—	—	—	—	—	—
KPROD²	3.8×10⁻⁶ (0.255)	-2.1×10⁻⁶ (0.860)	-2.0×10⁻⁵ (0.000)	—	—	—	—	—	—	—	—	—
INCOFF	-4.7×10⁻⁴ (0.771)	0.003 (0.149)	0.004 (0.038)	—	—	—	—	—	—	—	—	—
CASHCROP	0.002 (0.446)	-0.059 (0.006)	2.7×10⁻⁴ (0.748)	—	—	—	—	—	—	—	—	—
VVFEMPCT	-2.7 (0.388)	-5.8 (0.142)	1.0 (0.719)	—	—	—	—	—	—	—	—	—
POLYG	427.4 (0.190)	86.6 (0.717)	151.6 (0.628)	12608.8 (0.169)	2093.3 (0.046)	10493.1 (0.544)	57592.7 (0.001)	1273.1 (0.912)	-4755.2 (0.762)	-245.0 (0.764)	956.8 (0.103)	-15.9 (0.985)
FEMHEAD	-389.5 (0.349)	208.0 (0.591)	1812.5 (0.030)	-4948.2 (0.652)	-1139.7 (0.469)	-23169.4 (0.338)	-14390.1 (0.507)	-20271.4 (0.240)	-29243.8 (0.182)	-1783.5 (0.071)	-784.2 (0.366)	868.8 (0.453)
DEP-RAT	-8.4 (0.031)	-6.9 (0.138)	-5.6 (0.234)	-115.3 (0.317)	15.0 (0.442)	-93.8 (0.731)	227.4 (0.341)	-95.2 (0.658)	112.2 (0.638)	-16.2 (0.112)	-27.3 (0.015)	-28.6 (0.025)
AGEHHH	-11.2 (0.097)	4.19 (0.565)	-3.8 (0.622)	-630.9 (0.005)	-13.3 (0.687)	-183.8 (0.677)	-521.8 (0.223)	262.2 (0.470)	-105.7 (0.793)	-19.9 (0.323)	13.7 (0.468)	-14.4 (0.499)
NADULT	-160.2 (0.063)	-23.2 (0.749)	-33.2 (0.686)	-2513.2 (0.320)	-257.5 (0.423)	704.5 (0.877)	3532.4 (0.556)	-2300.8 (0.495)	-747.7 (0.855)	-130.1 (0.560)	-393.9 (0.042)	-276.5 (0.202)
EDHHH	-242.1 (0.228)	-30.7 (0.858)	-249.6 (0.237)	-10634.4 (0.082)	-1765.7 (0.081)	-23328.0 (0.041)	9004.0 (0.469)	-7673.0 (0.483)	7795.9 (0.454)	-936.0 (0.047)	592.5 (0.289)	381.5 (0.489)
TOTAREA	—	—	—	22472.3 (0.009)	616.8 (0.524)	-11536.4 (0.576)	7432.3 (0.651)	2445.1 (0.822)	79315.6 (0.000)	4006.4 (0.000)	2662.2 (0.000)	6531.8 (0.000)
COTAREA	—	—	—	—	—	—	-780.8 (0.021)	-646.5 (0.186)	—	-13.0 (0.251)	44.1 (0.117)	—
COTPEST	—	—	—	0.120 (0.000)	0.503 (0.000)	—	—	—	—	—	—	—
COTPEST³	—	—	—	-4.6×10⁻⁸ (0.000)	-3.0×10⁻⁶ (0.000)	—	—	—	—	—	—	—
CASHEW	—	—	—	950.5 (0.000)	2484.3 (0.000)	3806.0 (0.000)	118.4 (0.687)	2901.3 (0.550)	-60.7 (0.740)	53.9 (0.000)	-111.2 (0.650)	7.7 (0.427)
LVST	—	—	—	0.232 (0.147)	-0.010 (0.724)	0.299 (0.495)	0.959 (0.002)	-0.324 (0.302)	-0.033 (0.934)	-0.006 (0.654)	-0.007 (0.677)	0.007 (0.722)
OUTMIG	—	—	—	1992.7 (0.841)	327.0 (0.791)	8162.8 (0.794)	11892.4 (0.569)	-6542.2 (0.627)	7210.1 (0.799)	1814.6 (0.040)	-1209.6 (0.083)	-2784.6 (0.064)
FAL-CUL	—	—	—	0.9 (0.982)	1.3 (0.855)	-201.8 (0.030)	70.7 (0.367)	-10.0 (0.899)	117.7 (0.162)	-2.7 (0.436)	0.509 (0.901)	4.2 (0.346)
Constant	2,119.3 (0.000)	572.7 (0.330)	693.2 (0.223)	39386.7 (0.006)	1692.1 (0.457)	5669.3 (0.830)	23017.8 (0.438)	25572.5 (0.308)	-6332.4 (0.790)	3655.4 (0.004)	3024.6 (0.020)	3251.2 (0.011)
Adj. R²	0.890	0.786	0.690	0.554	0.602	0.760	0.250	-0.055	0.125	0.560	0.376	0.440

Source: Nampula Smallholder Survey.
*Numbers in parentheses are significance levels, calculated from adjusted standard errors.

areas of three districts in Nampula province. The sample is believed to be broadly representative of those smallholders in each district which have been less acutely affected by the war. Thus, study results likely reflect the situation of the relatively better-off portion of the rural population in these districts.

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.[16] 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.

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 appears to 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 apparently constrained land access for many households, means that food must be available for purchase if these households are to meet their consumption needs. But this food will not be available in

markets without sufficient effective demand, and such demand will not emerge unless smallholders can generate increased cash incomes through off-farm work or greater sales of cash or food crops. Thus, in either case, broader off-farm rural development is critical if the majority of Mozambican smallholders are to escape the poverty trap. Damage from the war means that the problems associated with this challenge are certainly greater but probably not fundamentally different from those in many other SSA countries. The ending of the violence is, of course, a *sine qua non* for any meaningful progress.

Cotton-growing enterprises may offer one way out of the quandary. By generating significant amounts of cash income in relatively small geographical areas (through both cotton sales and work in cotton processing plants), such enterprises might provide the base of effective demand needed for the emergence of stronger food and non-food markets. 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.[17] 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 might 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 nearly 20 years of neglect and sabotage of rural infrastructure mean that such development will be slow, even with significant infrastructural investment in rural areas. The return of *deslocado* families to the areas they inhabited prior to the war might also help reduce land pressure and improve access. But recall that the proportion of *deslocados* in this sample was not high. It is also not clear whether internal population movements will be large or rapid after the war.[18] Thus, it seems reasonable to conclude that the size and quality of land holdings will remain very important in determining the welfare of most rural households for the 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 the factors influencing land access in the smallholder sector should also be accorded high priority. Such research should sort 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. 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 are 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.

NOTES

1. See Kyle (1991) for a discussion of the ERP. Initial steps toward liberalization were taken in 1985, with the loosening of restrictions on fruit and vegetable marketing. The ERP was a more comprehensive liberalization effort, based in part on the positive supply response to the 1985 reforms.

2. See also Haggblade, Hazel and Brown (1989) and Reardon (1990) for a review of evidence on farm and non-farm income sources of sub-Saharan African smallholders.

3. These figures mask an improvement in the perceived quality of the diet as income increases, reflected by income elasticities of food expenditure that are generally much higher than the elasticities for calorie consumption.

4. The proportion of *deslocado* families in the sample was only 5% in Monapo and Ribaué, and 9% in Angoche, well below the countrywide average of 13.5% reported by Kyle (1991). Note that relative calm has prevailed since a peace accord was signed in late 1992.

5. See, for example, Carrilho *et al.* (1990), Martins (1992 and Martins, personal communication) and various issues of *Extra*.

6. Mozambique's density is nearly double that in Zambia, but is less than one-third of Malawi's, and is slightly lower than those in Tanzania and Zimbabwe.

7. Tsetse fly has in the past prevented the holding of large livestock in northern Mozambique.

8. Household income is 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, and is net of cash and in-kind payments made to hired labor.

9. Net availability is calculated by a disappearance method: $Ka = KP - (KS + KD + KL) + (KR + KB)$, here 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, the calculation does not consider calories given or received through traditional exchange mechanisms. Twenty-four hour consumption recall data indicate that such receipts vary from 1% of total calories in Angoche to 7.5% in Monapo. 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.

No adjustment is made in the table for pregnant and lactating women, since no data were gathered at the household level regarding this issue.

10. A household was classified as a net buyer (seller) if it bought (sold) more calories of the six food crops than it sold (bought).

11. See MOA/MSU/UA Research Team (1992a and 1992b) for more information on the structure of the rural marketing system.

12. Retained own production of staples 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.

13. If all markets existed and transactions costs of participating in them were minimal, these three inputs could appropriately be replaced by total income in the calorie consumption function. But widespread food market failure in the survey area, especially for purchases, suggests that each component may have differential effects on final calorie consumption. Understanding the effect of each is critical in designing policy to improve rural welfare.

14. Given the serious market failures identified in the survey area, the traditional approach would be to model the system simultaneously (Strauss, 1986; Goetz, 1992). At least three factors, however, recommend the "conditional recursive" approach used here. First, assuming endogeneity when a variable is in fact exogenous imposes high costs on the efficiency of the estimator (Bouis and Haddad, 1990). Second, a case can be made that the endogeneity or exogeneity of a regressor in a household model is, like market failure, household specific (de Janvry, Fafchamps and Sadoulet, 1991). For example, if neither labor nor land constrain the production of sufficient calories for the household, then once a household has devoted sufficient land to food crops to meet calorie needs, both cash cropping and off-farm work can be considered separable from the calorie consumption decision. Alternatively, if labor is not constraining but land is, and if food markets fail, then once the household has devoted all land to food crops, the off-farm labor decision is also separable from the caloric consumption decision. In both circum-

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stances, there are ranges within which decisions are likely not separable, and others within which they probably are. Thus, the separability of household decisions becomes an empirical rather than a purely theoretical issue. Finally, the model was first run using a two-stage least squares technique with estimated rather than actual values of COTAREA (equations 1 and 3), KPROD, INCOFF, and CASHCROP (equation 4) used *a priori*. Econometric differences between the two approaches were minor, and substantive conclusions did not change.

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.

16. One should note that the rural manufactures market has also been affected by the war and the highly controlled economic policies of the past. The widespread absence of consumer goods in rural areas reduced the incentive for market participation.

17. See Lele, Van de Walle and Gbetibouo, 1989) for a review of cotton experience in sub-saharan Africa, and a good discussion of the relative impotance of pricing factors relative to institutional or organizational ("nonprice") factors in determining the level of benefits accruing to participating smallholders.

18. Hundreds of thousands of refugees have already returned from Malawi, primarily into Tete and Niassa provinces.

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