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# **Coping Strategies in Post-War Rural Mozambique**

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## **Abstract**

This paper analyses post-war coping strategies by farm households in developing countries. The analysis is based on a portfolio model of activity choices in war-affected rural Sub-Saharan Africa. A case study using farm household survey data estimates the determinants of agricultural coping strategies in post-war Mozambique. Post-war coping strategies are expected to differ from pre- and mid-crisis coping strategies. War-affected households are forced to adopt very risky coping strategies that re-enforce their vulnerability. Households choose between market and non-market forms of exchange and even exit markets entirely. Post-war reconstruction policy should focus on re-capitalizing households and providing public goods.

## **Introduction**

The traditional coping strategy literature has focused on household activity choices leading up to, and during, natural disasters and famine. In contrast, this paper analyses *post-war* coping strategies by farm households in developing countries. The analysis is based on a model of farm household behavior which is derived from portfolio theory (Bodie and Merton 1998; Dixit 1990). The model considers the special circumstances of conflict in rural Sub-Saharan Africa, which are akin to a land abundant tropical economy (Binswanger and McIntire 1987).

Initial contributions to the literature on coping strategies analyzed responses to drought and famine (Corbett 1988; Reardon, Matlon and Delgado 1998). A related literature studied activity choices and income diversification (Ellis 2000; Reardon, Delgado and Matlon 1992). These choices are affected by household size and endowments (Abdulai and Delgado 1999; Taylor and Yunez-Naude 2000; von Braun and Pandya-Lorch 1991), by social institutions and property rights (Carter and Olinto 2003; Fafchamps and Lund 2003; Platteau 1999), by formal and informal markets or by their absence (de Janvry, Fafchamps and Sadoulet 1991; Key, Sadoulet and de Janvry 2000; Leonard 2000; Liedholm, McPherson and Chuta 1994) and by location and geography (Dercon and Krishnan 1996; Goetz 1992). Coping strategies include the decision of whether to engage in markets at all (Binswanger and McIntire 1987), the choice of crop or production technique (Sperling and Longley 2002; von Braun and Kennedy 1994) and non-market forms of risk diversification (Blarel, et al. 1992; Dercon and Krishnan 2000). Policy makers are concerned about activity choices and their impact on rural poverty (Adams 2002; Dercon 2002), or as a means of mitigating the negative effects of disasters (Sperling and Longley 2002; Webb and von Braun 1994). The traditional literature has not, however, considered coping strategies and activity diversification in situations of war. In fact, there is very little analysis to date of the micro-economic behavior of farm

households in times of conflict. Hence the analysis of coping strategies after war is the unique contribution of this paper.

A case study using farm household survey data estimates the determinants of agricultural coping strategies in post-war Mozambique. There is a lively debate on income diversification and cash crop adoption in Mozambique (Cramer and Pontara 1998; Heltberg and Tarp 2002; Pitcher 1998; Tschirley and Benfica 2001; Tschirley and Weber 1994). Another literature records the economic effect of the devastating civil war in Mozambique (Addison and de Sousa 1999; de Sousa 2003; Wuyts 2003). This article differs from that literature by focusing on the long-term effects of war on farm household production choices.

The analysis demonstrates that post-war coping strategies differ from pre- and mid-crisis coping strategies. War-affected households have a higher demand for risk diversification yet they may be severely constrained in their activity choices. Such households are forced to adopt very risky coping strategies that re-enforce their vulnerability. Households choose between market and non-market forms of exchange and even consider exiting markets entirely, an option not often considered by basic models of farm household behavior. These findings have strong implications for post-war reconstruction policies.

The paper is structured as follows. The next sections develop a formal model of household coping strategies with two risky income activities and discuss the effects of war in the model. The subsequent section introduces the case study, reviews methodological and data issues and derives the econometric specifications. This is followed by a discussion of some summary statistics, the econometric results and policy implications. The last section concludes.

### **A Model of the Determinants of Coping Strategy**

This section develops a simple model of the choice between two coping strategies. Activity or coping strategies refer to the household labor allocation between different income generating

tasks. The main activity distinctions are between on- and off-farm (or agricultural and non-agricultural) activities and between subsistence and market activities.

Consider a farm household with two production activities  $i = 1$  or  $2$ . (The model can be generalized to more than two activities.) Assume that land is abundant so that there are no credit or labor markets: the total labor supply equals household labor supply  $L$ . Asset endowments of households are given in each period and are normalized at 1. The main risk in household production derives from  $V$ , the variance of portfolio revenue net of costs:

$$\begin{aligned} V &= s_1^2 - 2q(s_1^2 + s_{12}) + q^2(s_1^2 + s_2^2 - 2s_{12}) \\ s_{12} &= \rho_{12}s_1s_2 \end{aligned} \quad (1)$$

where  $q$  is the share of labor dedicated to activity 1,  $s_i$  is the standard deviation of the return of the  $i^{\text{th}}$  activity (for  $i = 1$  or  $2$ ),  $s_{12}$  is the covariance of returns between the two activities 1 and 2, and  $\rho_{12}$  is the correlation coefficient of the returns from both activities. This yields:

$$\begin{aligned} \partial V / \partial q &= -2s_1^2 + 2qs_1^2 + 2qs_2^2 + 2s_{12} - 4qs_{12} \\ \partial V / \partial q &= -2s_1^2 < 0 \quad (\text{for } \rho = 0 \text{ and } q = 0) \\ \partial V / \partial q &= 2s_2^2 > 0 \quad (\text{for } \rho = 0 \text{ and } q = 1) \\ \partial^2 V / \partial q^2 &= 2s_1^2 + 2s_2^2 - 4s_{12} \\ \partial^2 V / \partial q^2 &> 0 \quad (\text{for } \rho = 0) \\ q_{V\min} &= s_1^2 / (s_1^2 + s_2^2) \quad (\text{for } \rho = 0) \end{aligned}$$

where  $q_{V\min}$  denotes the share of labor allocated to the second activity such that total portfolio risk is minimized. Total farm production  $X$  is defined as:

$$\begin{aligned} X &= X_1(L_1) + X_2(L_2) \\ &= a_1q_1 + a_2q_2 \end{aligned} \quad (2)$$

$$L \leq L_1 + L_2 \quad (3)$$

where  $a_i$  is the activity-specific constant returns to scale (CRS) production technology. Total farm revenue net of variable, non-labor inputs  $R$  is given by:

$$\begin{aligned} R &= R_1 + R_2 \\ &= p_1X_1 + p_2X_2 \end{aligned} \quad (4)$$

where  $p_i$  are farm-gate output prices. Farm-gate prices are net of transaction costs  $t_i$  so that:

$$p_i = p_i^* - t_i \quad (5)$$

where  $p_i^*$  are given wholesale market prices. Transaction costs for each commodity are determined by given household characteristics and market imperfections. This implies that commodity prices and commodity market failure are household-specific.

At the beginning of the agricultural year, a household allocates its labor supply  $L$  between activities for given expected revenues, preferences, endowments and local climatic conditions:

$$\begin{aligned} E(R) &= E(p_1)E(X_1) + E(p_2)E(X_2) \\ &= E(p_1)a_1(1-q) + E(p_2)a_2q \\ &= E(p_1)a_1 - qE(p_1)a_1 + qE(p_2)a_2 \end{aligned} \quad (6)$$

$$\begin{aligned} q &= q_2 \\ &= L_2 / L \end{aligned} \quad (7)$$

and where  $E(.)$  denotes the expectations operator.

The subjective wage  $W$  for household labor is defined as the amount of output a household would require as compensation for a given unit of leisure foregone. This is captured here through the subjective wage rate  $w$  such that total subjective equilibrium labor costs per household are:

$$\begin{aligned} W &= wL \\ &= wL_1 + wL_2 \end{aligned} \quad (8)$$

These wage costs are affected by the specific household characteristics, which define the dependency ratio and thus the leisure-work trade-off. Total household profits  $\Pi$  are defined as revenue net of subjective labor costs:

$$\Pi = R - W \quad (9)$$

so that expected profits are:

$$E(\Pi) = E(R) - W \quad (10)$$

The rate of return  $\pi$  of the activity portfolio is then given by:

$$\begin{aligned}\pi &= \Pi/R \\ &= 1 - (W / R) \\ \partial\pi/\partial R &> 0 \text{ and } \partial^2\pi/\partial R^2 < 0\end{aligned}\tag{11}$$

The expected rate of return is thus given by:

$$E(\pi) = 1 - (W / E(R))\tag{12}$$

The farm household utility function  $U$  contains two elements: one representing expected portfolio profits and one representing the expected portfolio risk:

$$\begin{aligned}U &= U(\Pi, V) \\ \partial U/\partial \Pi &> 0, \partial^2 U/\partial \Pi^2 < 0, \partial U/\partial V < 0 \text{ and } \partial^2 U/\partial V^2 > 0\end{aligned}\tag{13}$$

Households maximize utility with respect to the labor allocation subject to the labor constraint:

$$\begin{aligned}\max U &= U(\Pi, V) \\ \text{w.r.t. } q & \\ \text{s.t. } & 0 \leq q \leq 1\end{aligned}\tag{14}$$

Assuming  $\rho = 0$  and additive utility, this is solved as follows:

$$\begin{aligned}U &= R - W - V \\ &= p_1 a_1 - q p_1 a_1 + q p_2 a_2 - W - s_1^2 + 2q s_1^2 - q^2 s_1^2 - q^2 s_2^2 \\ \partial U/\partial q &= -p_1 a_1 + p_2 a_2 + 2s_1^2 - 2q s_1^2 - 2q s_2^2 = 0 \\ \partial^2 U/\partial q^2 &= -2s_1^2 - 2q s_2^2 < 0\end{aligned}\tag{15}$$

so that this utility function, with a negative sign of the risk aversion parameter  $U''/U'$ , implies risk aversion. Rearranging the first order condition yields:

$$\begin{aligned}q &= - (p_1 a_1 - p_2 a_2 - 2s_1^2) / 2(s_2^2 - s_1^2) \\ &\geq 0 \\ &\leq 1\end{aligned}\tag{16}$$

The numerator of equation 16 is negative and the denominator is positive such that:

$$\partial q/\partial p_1 < 0, \partial q/\partial p_2 > 0, \partial q/\partial a_1 < 0, \partial q/\partial a_2 > 0,$$

$$\partial q / \partial s_1 > 0, \partial q / \partial s_2 < 0, \partial q / \partial t_1 > 0 \text{ and } \partial q / \partial t_2 < 0$$

Assuming additive utility is non-trivial as a multiplicative functional form would result in a different specification of  $q$ :

$$\begin{aligned} U &= \Pi / V \\ \partial U / \partial q &= (\partial \Pi / \partial q V - \Pi \partial V / \partial q) / V^2 = 0 \end{aligned} \tag{17}$$

where the first order condition also includes a term for profits and thus for the subjective wage. This implies that for farm household production in the absence of labor markets and with no riskless activity to engage in, household preferences affect the optimal allocation of resources between risky activities through both the profit and the utility functions. This result does not hold for households facing perfect markets and a riskless investment opportunity. This model differs from standard models of farm production under uncertainty by emphasizing the absence of labor and output markets, the existence of a survival constraint, and the role of the subjective valuation of labor.

Figure 1 summarizes the model where quadrant I plots the profit function (equation 12), quadrant III plots the production function (equation 6), quadrant IV plots the risk function (equation 1) and quadrant II plots the utility function (equation 13) in risk-return space. Quadrant II also summarizes the trade-off between risk and return in the activity portfolio. Households prefer higher expected returns and lower portfolio risk so that  $U_3 > U_2 > U_1$ . At point a,  $q = 1$  and the household specializes in activity 2. At point d,  $q = 0$  and the household specializes in activity 1. At point c, the portfolio has the lowest possible risk  $V_{\min}$  and  $q = q_{V_{\min}}$ . Curve abc represents the efficient portfolio frontier.

Equilibrium is obtained at point b where abcd is tangential to the highest possible utility curve  $U_2$ . The equilibrium level of  $q$  is  $q^*$  which is larger than  $q_{V_{\min}}$  (figure 1). The household will thus decide at the beginning of the agricultural season to allocate  $q^*$  of its labor to activity 2 and  $1 - q^*$  to activity 1. The expected shares of revenue from activities 2 and 1 are therefore



$q^*$  and  $1 - q^*$ , respectively. Given the prevalent uncertainty, these labor allocation and expected revenue shares are only approximate indicators of the actual output shares per activity at the end of the period. Note that more risk averse households would choose a labor allocation closer to  $q_{Vmin}$ .

### **War and Coping Strategies**

This section outlines the effects of war on the basic model of activity choices. The nature and the determinants of coping strategies during and after conflict will be discussed.

War has three effects on the risk-risk relationship of the basic model (equation 1). First, the increase in overall risk due to war will shift the whole curve right ( $\partial V/\partial s_i > 0$ ) with the war legacy ensuring that the post-war outcome will still be to the right of the pre-war case. Second, the relative changes in risks (say  $\Delta s_1^2/\Delta s_2^2 < 1$ ) will shift the lower section of the curve even further to the right ( $\partial V/\partial s_2 = 2q^2s_2$ ). With a large  $q$ , an increasing  $s_2$  leads to a further increase in  $V$ . This effect is reduced in the post-war period. Third, the increase in the correlation coefficient flattens the slope near  $q_{Vmin}$  ( $\partial(\partial V/\partial q)/\partial s_{12} = 2-4q$ ) thus reducing the scope for risk reduction through portfolio diversification. In the post-war period, there is still a higher correlation coefficient though its scale may be lower than during the war. The net effect of the changes is that, during war, the curve  $abcd$  shifts down and to the right to an area of unambiguously lower utility for the household. In the post-war period, the curve will shift partially back towards the peace-time position (2).

War will change the profit function (equation 9) by affecting revenue and the equilibrium value of the subjective wage, in particular via enforced life-cycle effects in the household. This is most likely to occur through conflict-related morbidity and mortality in the household, especially in households near the survival threshold. If disaster is imminent, then  $W$  will be low and the risk of production and correlation coefficient of returns are likely to be very high,

thus reducing the potential gain from diversification. In the post-war period, households may remain in such high risk, near starvation equilibrium, depending how quickly the value of subjective wages can rise under peace conditions. Given strong war effects, many households may exist in the post-war poverty trap in the bottom right corner of quadrant IV in figure 2.

This model can therefore resolve the apparent paradox noted in the safety-first literature where destitute households engage in very risky behavior even though they are least able to withstand the risks inherent in such a portfolio. It does so by valuing the trade-off between leisure and labor in regard to the survival constraint through the term  $W$ , which captures the household consumption requirements.

Household assets and social capital affect the technical efficiency of production and hence  $a_i$ . With land abundance and damaged credit markets, assets fulfill a key role as both productive inputs and as a self-insurance mechanism in a risky environment. At the same time, assets are key targets of soldiers and looters. Asset characteristics thus make some activities more vulnerable to war than others. For example, cattle herding may be a productive and a risk-mitigating activity in peace-times. Nevertheless, cattle herding becomes unfeasible in a long-lasting war of destabilization and may not be worthwhile (due to an expected resumption of hostilities) or possible (due to the collapse of cattle markets and extension services) in a high risk, poor post-war environment. Households depend on their land and their social capital for production and social exchange. The portfolio of endowments therefore affects the portfolio of activities undertaken.

The model implies that war-affected households facing substantial market constraints smooth consumption by smoothing income. This result does not obtain in the standard farm household model. Households affected by war hence behave differently from households in peace-time economies. Rural post-war reconstruction policies must support these income

smoothing activities while helping to re-establish markets to allow once again consumption smoothing.

War also affects production technologies and relative prices so that both  $a_i$  and  $p_i$  in equations 2 and 4 can be expected to fall. In the case of food crops ( $i=1$ ) versus cash crops ( $i=2$ ), it is also likely that  $\Delta a_1/\Delta a_2 < 1$  and  $\Delta p_1/\Delta p_2 < 1$ , as war increases the transaction costs for cash crops relatively more than for food crops and as cash crops have a given world price. In addition, war is likely to enforce the extended use of traditional cropping patterns, seeds and techniques. To the extent that these techniques are more divisible than modern agronomic practices (irrigation being an extreme example of an indivisible modern technique), households adopt a larger number of individual activities within each activity class during the war while reducing the dependence on cash crops. Such traditional techniques include the number of traditional food crops, dividing the cultivated area per household into more but smaller plots and pursuing intensive-intensive off-farm activities.

In terms of figure 2, a proportionate reduction of the parameters  $p_i$  and  $a_i$  will shift the  $E(R)$  curve to the right in quadrant III. A disproportionately large reduction of the  $p_2$  and  $a_2$  parameters will also reduce the slope of the curve. These war-induced changes in the technology and price variables may only be reversed partially in the post-war period.

Household activity diversification is also encouraged by institutional and market imperfections, which are worsened by war. Such imperfections affect the degree of technology embedded in production ( $a_i$ ) and the farm-gate prices ( $p_i$ ) net of transaction costs ( $t_i$ ). The total labor availability ( $L$ ) is also shaped by market imperfections, especially through increased search, information and supervision costs in land abundant areas which lead to reduced supply of and demand for labor and hence to the breakdown of wage labor markets. Consequently, the variables  $L$ ,  $w$  and  $W$  in equation 8 are shaped by the effects of war on institutions.

Household social capital is a key determinant of the profitability of low-return, off-farm activities, including social exchange and NGO donations. Households with higher social capital (for example households who hold a position of traditional authority in their community) are thus much more likely to command larger labor resources  $L$ , have lower transaction costs  $t_i$  and achieve higher net prices for off-farm activities  $p_2$ .

Formal and even informal credit markets may cease to exist during war. This is due to the high cost of information gathering, the reduced ability to enforce contracts while state authority is so severely threatened and the high degree of risk covariance which increases the undiversifiable portfolio risk for lenders. Credit-constrained households are thus likely to increase their share of informal, social, non-market activities to substitute for war-affected credit markets.

Given the reduced number of feasible choices under war conditions, there is an externality effect of household market withdrawal. At the margin, one more household reducing its market participation will prevent all other households from joining a market. This effect is particularly pronounced if households' transaction costs are uniformly affected by the war, creating a high covariance of risks, and covariant household activity choices. This is a further reason for market breakdown in war conditions.

Volatile markets increase the incentives for households to engage in subsistence activities. "Village enclaves" (Dasgupta 1993: 235) are more pronounced in a post-war environment and location will be a strong determinant of household behavior. These effects may create village-level poverty traps, from which no individual household can endogenously free itself.

### **The Case of Mozambique**

Rural Mozambique provides a suitable case study for war-affected coping strategies as it experienced a devastating civil war until 1992. For example, the number of cattle in

Mozambique declined from over 1.3 million in 1982 to 0.25 million in 1992 (Ministério da Agricultura 1994). Farm productivity in the post-war period continued to remain well below regional averages (Tschirley and Weber 1994) while per capita food production only reached 90 percent of its pre-war level by 1996 (World Bank 2002). In 1995, gross domestic product per capita was only 146 US dollars (World Bank 2002) and in the Human Development Index Mozambique ranked among the ten least developed countries in the world (UNDP 1999).

The north of Mozambique is often considered the “green belt” of the country. However, post-war agricultural production was hampered by poor transport networks and the absence of irrigation infrastructure and of mechanized agricultural production. There were few agricultural or non-agricultural employment opportunities and no migrant workers and no formal credit markets.

The farm household survey used for this analysis includes 371 randomly selected households in 16 villages (the primary sampling units, PSU) in three districts in Nampula and Cabo Delgado provinces in northern Mozambique (MAP/MSU Research Team 1996). The findings of the survey are broadly representative of the more accessible parts of northern Mozambique. The sample was stratified according to households’ cotton growing status. The survey data, here denoted FSP, was collected by the Food Security Project at the Ministry of Agriculture, Maputo, from June 1994 to January 1996. All variables below will refer to the year 1995 unless stated otherwise. The variables are summarized in figure 2. The FSP survey is one of the most carefully designed, collected, and cleaned rural household surveys from the early post-war period in Mozambique. The evidence provided by the FSP survey is complemented by qualitative data collected during two visits to northern Mozambique in 1995 and 1999.

### **Specification Issues**

Equation 16 defines the functional form for  $q$  as:

$$q = - (p_1 a_1 - p_2 a_2 - 2s_1^2) / 2(s_2^2 - s_1^2)$$

where  $q$  must lie in the interval 0 to 1. The equilibrium determinants of  $q$  are closely related to the independent parameters  $p_i$ ,  $a_i$  and  $s_i^2$ . Depending on the functional form of the utility function,  $q$  also depends on  $\rho_{ij}$  and  $W$ . This implies that subjective wages and household endowments matter for activity choices. Furthermore, war requires controlling for the subjective valuation of leisure and household- and village-level transaction costs (equation 5).

Taking  $q$  as an indicator of activity choices and replacing the model parameters  $p_i$ ,  $a_i$ ,  $s_i^2$ ,  $\rho_{ij}$ , and  $W$  with corresponding household survey indicators thus yields the reduced-form equation:

$$q_i = \alpha_0 + \alpha_1 \mathbf{L}_i + \alpha_2 \mathbf{F}_i + \alpha_3 \mathbf{K}_i + \alpha_4 \mathbf{V} + e_i \quad (18)$$

where  $\mathbf{L}_i$ ,  $\mathbf{F}_i$ ,  $\mathbf{K}_i$ , and  $\mathbf{V}$  are vectors representing household, land, asset endowments and village-level characteristics, respectively, and where  $e_i$  is an error term which is not correlated with the exogenous variables thus yielding unbiased and consistent estimates for the vectors of coefficients  $\alpha_h$  for households  $i = 1 \dots N$  and groups of coefficients  $\alpha_h$  for  $h = 0 \dots 4$ .

Equation 18 is not restricted to a specific functional form and may thus be guided by theoretical considerations, practical experience and statistical tests. A priori considerations and experience suggest mainly linear, log-linear and quadratic forms for the independent vectors  $\mathbf{L}_i$ ,  $\mathbf{F}_i$ ,  $\mathbf{K}_i$ , and  $\mathbf{V}$ . This specification thus corresponds closely to those used in the literature on household income diversification (Reardon, Delgado and Matlon 1992).

Some of the decisions, for example to participate in markets or to adopt cotton, are discrete choices which cannot be modeled with the linear approach. Instead, assume that a household participates in a market if it considers it to be a profitable move such that:

$$\begin{aligned} q_i &= 1 \text{ if } \pi_i > 0 \\ q_i &= 0 \text{ otherwise} \end{aligned} \quad (19)$$

where  $\pi_i$  is the expected rate of profitability of market participation for household  $i = 1 \dots N$ . Furthermore, assume that the profitability of the activity is determined by a model akin to that of equation 18. The binary model to be estimated is then:

$$\text{Prob}(q_i = 1) = F(\alpha_0 + \alpha_1 L_i + \alpha_2 F_i + \alpha_3 K_i + \alpha_4 V) \quad (20)$$

where  $F$  is a cumulative probability function closely related to equation 18. This model can be estimated by logit or probit, if the error term follows a logistic or normal distribution, respectively. Such a model thus estimates the probability that a household undertakes a certain activity given the household's endowments, preferences and the prevailing prices. Following Cramer and Ridder (1991), a binary (not a multiple-category) variable was adopted for this analysis to capture the essential difference between no market participation on the one hand and some form of market participation on the other hand.

One interpretation of  $q$  in equation 18 is as the share of net household income from agricultural activities (SHAREON). The share of subsistence (i.e. non-market) income is denoted  $1 - q$  (SHARESUB) and the share of market income  $q$ . The categorical variable STATUS3 identifies households which have some degree of crop market participation, defined by the value of crops sold in the market. Other variables break output market participation down into sub-groups such as "selling food crops only", "selling cash crops only" and "selling food and cash crops" (STATUS2), where cash crops are defined as inedible crops. The categorical variable COTTON measures whether households plant any cotton at all, which implies  $q > 0$  in the model above.

One non-monetary and non-market indicator of household diversification is PLOTFRAG, which measures the degree of spatial diversification of farm households or farm fragmentation. Formally, PLOTFRAG is defined as the natural log of the weighted Herfindahl-Hirschman Index (HHI) of plot diversification:

$$HHI = 1 / (\sum q_i^2), i = 1 \dots N \quad (21)$$

where  $q_i$  is the share of plot  $i$ 's area of the total cultivated area per household and  $N$  is the total number of plots farmed per household. The HHI is weighted by the area cultivated per household to allow comparisons across households irrespective of farm size. PLOTFRAG is almost normally distributed.

Another measure of non-market diversification is the degree of social exchange (EXCHANGE). This is defined as the natural log of the sum of the absolute value of remittances and social exchange both given and received between January and September 1995 (the data for the remaining three months of 1995 is incomplete). EXCHANGE measures the sum of the absolute values as the actual flows given and received may cancel out, which would underestimate the degree of social exchange.

## **Results and Discussion**

### *Summary Statistics*

Households are very dependent on subsistence food crop activities for their income, with cash crops contributing only a small share to total income but three quarters of all crop marketing income (table 2). Entrepreneurial, wage and social income account for even smaller shares of household income. The high shares of on-farm income (SHAREON) and non-market income (SHARESUB) of total income suggest that households in northern Mozambique in 1995 were still practicing many of their war-time subsistence coping strategies.

Table 3 compares these findings to those from 28 other farm surveys from Sub-Saharan African countries, which report lower on-farm and higher off-farm income shares. Interestingly, the share of social income is also higher in the other surveys, suggesting that war may also reduce a household's capacity to generate social income. Other authors report household income shares from off-farm activities in African countries of between 30% and



50% occasionally reaching 90% (Ellis 1998; Reardon 1997; von Braun and Pandya-Lorch 1991). It is thus apparent that the share of off-farm income in the post-war FSP survey is particularly low.

Household output market participation decisions were very flexible in post-war northern Mozambique (table 4). The FSP survey recorded crop sales for the two agricultural years ending 1994 and 1995. 43% of all households did not change their market participation status between 1994 and 1996, 20% of all households either added another type of crop or specialized in cash crops and 38% reduced the number of types of crops sold or even resumed a pure subsistence status. In fact, the total share of households marketing some cash crops dropped from 63% to 54% while the share of pure subsistence households increased from 13% to 21% in one year. These figures show that households adjust their market participation in the face of a variety of changing constraints from year to year and that households differentiate their market participation decisions between food crop and cash crop markets.

#### *Degree of On-Farm Activities*

The SHAREON regression (table 5a) is highly significant and has a good fit with an  $R^2$  value of 0.59. The positive coefficient of ANIMAL suggests that having more livestock helps to increase agricultural income activities. This may be related to the synergies derived from livestock ownership (especially in the post-war absence of commercial farm inputs like fertilizers) and to the war-induced absence of credit markets for off-farm activities, which implies that livestock plays no role as a collateral in credit transactions.

The social capital variables are entirely insignificant. This is slightly surprising as investments in social institutions could be a key response by households to high post-war levels of uncertainty. Their insignificance may derive from three sources. First, the share of social income in total income is very small thus reducing the role of social institutions in explaining income shares. Second, social institutions may be less important than anticipated if

their determinants are equal to those of market activities. In that case, market and social exchange are not substitutes but complements. Third, the proxies for social institutions included in the FSP survey may only measure such institutions imperfectly.

#### *Autarky versus Crop Market Participation*

The STATUS3 regression (table 5b) is highly significant. One village indicator variable was dropped, as that location predicted crop market participation perfectly, and 21 observations were not used. Households with a higher dependency ratio have a strongly reduced probability of crop market participation, indicating household-specific propensity to participate in crop markets. A higher household human capital increases market participation (EDUMAX, EDUMAXSQU). In a review of evidence on the effects of education in the rural economy, a similar effect of education was noted (Taylor and Yunez-Naude 2000). There appears to be no link from education to farm output but a link from education to farm activity choices in Africa.

Total farm size in 1994-95 (AREATOTAL) is a highly significant factor. This result implies that there are fixed transaction costs of market participation. Households with larger land endowments may have a comparative advantage in farming, lower transaction costs of land acquisition or market imperfections can be better internalized by larger scale farms. Strongly war-affected households may thus be doubly constrained in their reconstruction efforts. First they have less land for farming and second they have less access to crop markets, with the former effect reinforcing the latter.

The probability of crop market participation is reduced by owning more agricultural tools per household (TOOL) and increased by owning a larger range of agricultural tools (TOOLTYPE). Note that tool ownership is exogenous as households in the sample area had no access to markets for tools in that year. The ownership of livestock at the end of the war (ANIMAL) is a positive determinant of current crop market activity. Households which had

been subjected to asset destruction during the war were thus damaged in their ability to rejoin crop markets for many years to come even after the cessation of violence.

#### *Degree of Subsistence Activity*

The SHARESUB regression (table 5c) is highly significant and has a good fit with an  $R^2$  of 0.46. A variance inflation factor (VIF) analysis does not suggest a presence of significant multicollinearity. The determinants of the degree of market participation (SHARESUB) differ significantly from those for the basic decision of whether to participate in any markets at all (STATUS3). For instance, the scale effect operates through household size, and hence lifecycle effects, and not through farm size. Female-headed households, whose market participation does not differ systematically from that of other households, on average have a share of subsistence income 11 percentage points higher than other households (FEMHEAD). Female-headed households enter crop markets like other households but their share of market-based income in total income is much lower.

Environmental and social risks induce households to engage in market activities because those risks are less correlated with market risks and thus offer scope for risk diversification. Social and village level variables also strongly affect household market participation decisions. It is likely that the war increased the importance of these factors and that they will only slowly diminish in importance in the post-war northern Mozambican context.

#### *Cash Crop Adoption*

The logit regression of COTTON (table 5d) is significant with a p-value of 0.011. Educational variables (EDUMUM, EDUMUMSQU) are not significant determinants of cash crop adoption. A Ugandan farm household study found a similar absence of educational achievements on crop adoption (Appleton and Balihuta 1996). That study also analyzed a

post-war economy, suggesting that the adoption effects of education are more limited when general economic circumstances are unfavorable for growth and poverty alleviation.

Instead, the adoption of cotton in the post-war period in northern Mozambique is shaped by the household composition, availability and valuation of labor, by alternative investment opportunities and returns, and by comparative advantage as determined by local climatic and institutional conditions. The risk attitude and risk bearing capacity of households determine if households are willing to adopt cotton. Female-headed and local political status, for example, almost perfectly predict cotton adoption for almost 10% of the sample. A significant lifecycle effect occurs through the mean age of the household (AGEHH, AGEHHSQU). The war affects household cash crop decisions indirectly through the subjective value households attach to their labor, which are in part determined by a household's experience of the recent war. These indirect effects of war are very difficult for public policy to remove and it is likely that such differences will persist over a long time.

#### *Plot Diversification*

The determinants of PLOTFRAG are shown in table 5e. The regression is highly significant, has a reasonable fit with an  $R^2$  of 0.39 and has no apparent problem of multicollinearity as determined by VIF analysis. Given the significance of gender and household size coefficients, the household labor constraint is an important determinant of plot diversification. This finding is supported by interview evidence with agronomists in northern Mozambique. These interviews confirmed that planting fields benefited from being done quickly to utilize the best “window of opportunity” appropriate for that field. With more but smaller fields, households can spread these points in time and thus manage a larger cultivated area with a given amount of labor. These results confirm the hypothesis that households in the post-war period react strongly to some types of risks by altering their non-market production behavior.

Plot diversification is also a response to life cycle effects and household endowments, with gender having a strong effect on plot diversification. Household assets reduce such diversification while some soil characteristics and social capital have less importance. Finally, market opportunities help reduce spatial diversification while market risks increase it. Households which are emerging from a position of war-induced isolation are thus clearly using non-market diversification strategies.

### *Social Exchange*

The EXCHANGE regression (table 5f) is highly significant and has a reasonable fit ( $R^2 = 0.37$ ). A VIF analysis does not suggest the presence of multicollinearity. The result is robust to the omission of the zero-exchange households. Having many women (FEMALE, FEMALESQU) or men (MALE, MALESQU) in the household increases social exchange. Both effects are quadratic with minima at 4.0 and 2.7 persons, respectively. This confirms the dependence of rural social networks in Mozambique on very large families (Garrett and Ruel 1999).

Likewise, intergenerational dependence is a strong determining factor for informal social security mechanisms, with younger and older household heads (AGEHEAD, AGEHEADSQU) being more involved in transfers. The significant effects of the mean household age (AGEHH, AGEHHSQU) could represent the accumulation of contacts, a form of social capital, which is necessary in conducting exchange.

Better asset-endowed households can afford more insurance while also being more capable of utilizing self-insurance mechanisms. Social exchange thus appears to be an insurance mechanism for better-off households. Households in which the husband comes from the local village (ORIGINMAN) have much lower social exchange than other households. Therefore, the move of husbands to the village of their wife sometime after their wedding, as is common

practice in northern Mozambique, helps to build long-distance sources of remittance and social income. This tradition reduces the correlation of income within small areas.

## **Conclusions**

The analysis demonstrated that post-war coping strategies include many different market and non-market activities. In the post-war period, households pursue diversified activities as a response to the varying war legacy and to peace-time opportunities. Post-war behavior exhibits a surprisingly high degree of variance across activities. Particularly market participation rates fluctuate strongly across households and seasons.

Determinants of post-war diversification are primarily the indirect war effects. These include risk, the household life cycle position, household endowments, and transaction costs at the household and village levels. The strong role of life cycle effects indicates the importance of land abundance for the study of war-affected African farm households, especially via the negative effect of war on the marginal value of effort. The estimated determinants are consistent with the model proposed initially. They indicate a stronger emphasis on household and village characteristics in the determination of activity choices than standard farm household models would have suggested.

Households may become risk takers near the absolute survival threshold by specializing in fewer activities and completely reducing their asset base to survive into the next season. This is primarily the result of the war-induced destruction of many alternative activity options. The past war has a strong effect on future outcomes for poor farm households.

There is a difference between the determinants of a categorical decision to participate in output markets and the determinants of the continuous degree of market participation. The former is more affected by household life cycle, endowment and scale effects while the latter is strongly affected by the household risk experiences, social capital and village level

variables. For instance, female-headed households have the same market participation pattern but a smaller market income share than male-headed households.

Social activities are adopted by households which face only commodity-specific market failure. For households facing market failure across a whole range of products and services social contacts may not offer a significant alternative income source in the post-war, rural context.

Farm households practice various non-market forms of activity diversification. The regression analysis focused on spatial diversification and social exchange as two such examples. Surprisingly, social exchange is quite limited after the war, in part due to the widespread absolute poverty in the sample area. Its determinants are similar to those of output market participation. Social exchange is thus no alternative to market participation for the poorest and most war-affected households.

Village level effects are extremely important determinants of coping strategies. This implies that the government and donors can assist household coping strategies by providing public goods to enhance market participation and diversification opportunities. Post-war public policy must recognize the importance of local differences in the experience of war and prioritize assistance depending on the local war legacy.

Finally, other important determinants of post-war coping strategies include household labor characteristics, asset endowments, farm size and social capital. Reconstruction policy should therefore aim to re-capitalize war-affected households, enhance human capital and reduce rural transaction costs to affect the whole range of diversification determinants. Lowering war-induced transaction costs will have strong positive effects on the market participation and off-farm earnings of agricultural households.

Figure 1: The Two-Activity Farm Household Model

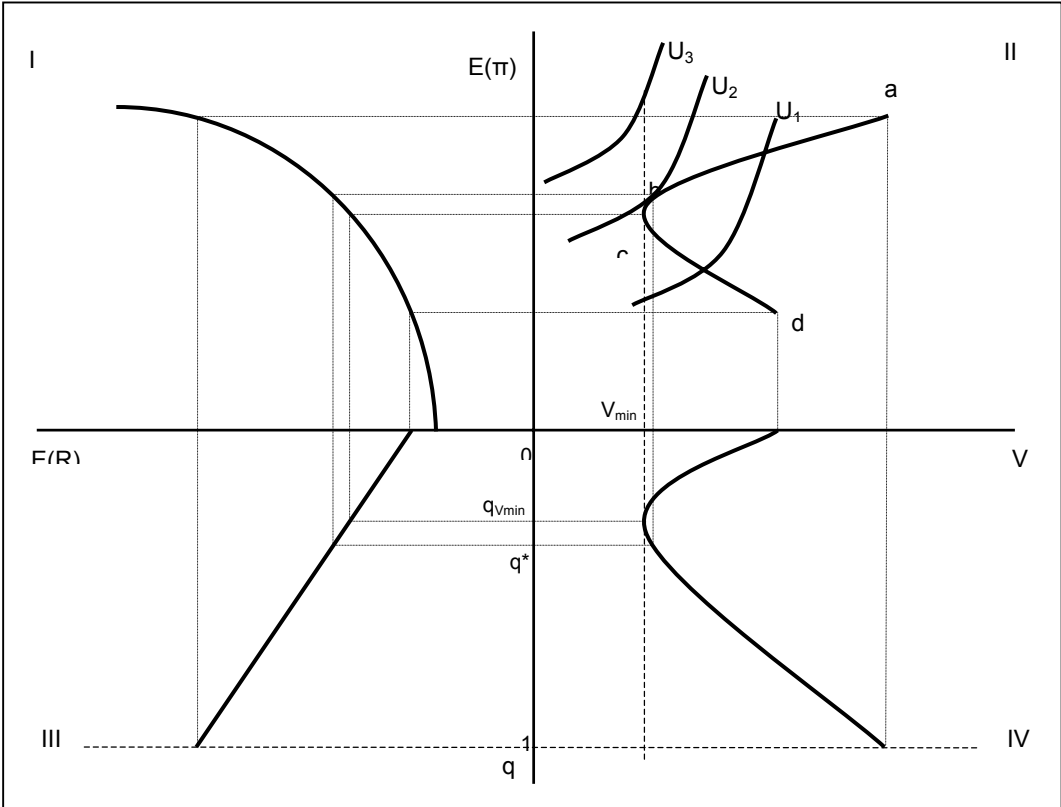
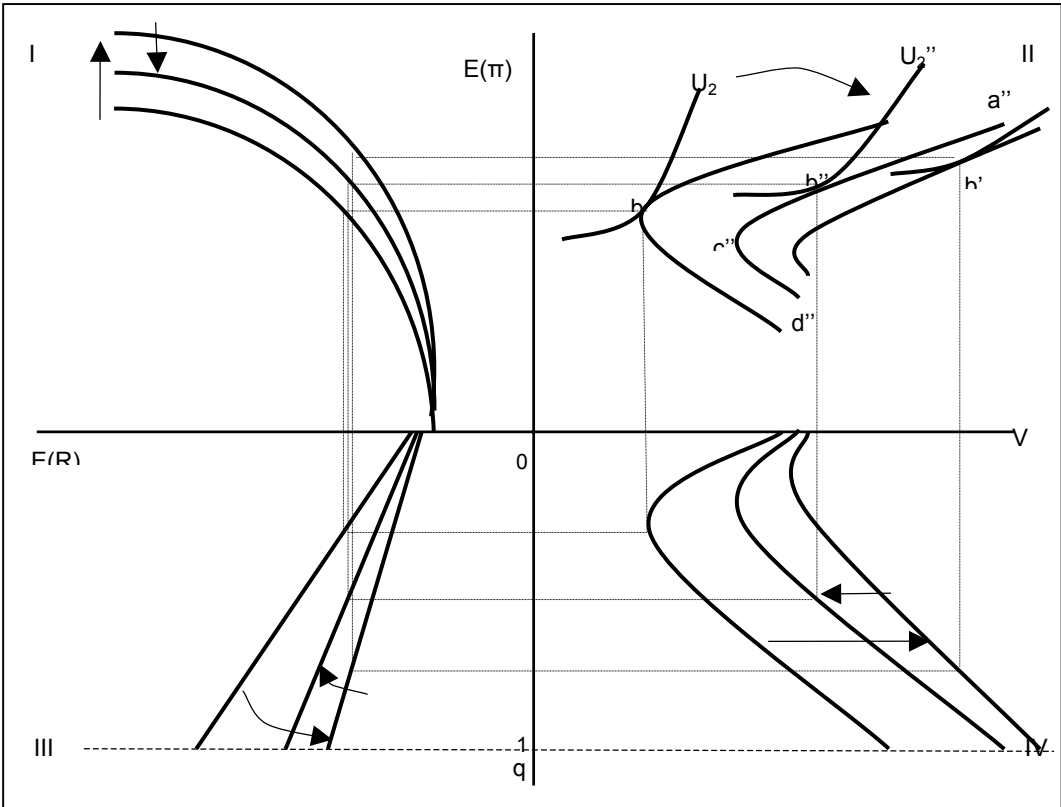


Figure 2: The Effects of War in the Two-Activity Farm Household Model





**Table 1: The Variables of the FSP Survey**

| Name                      | Definition   | Mean      | St Err  | Min    | Max        |
|---------------------------|--|-----------|---------|--------|------------|
| <b>Activity Variables</b> |  |           |         |        |            |
| COTTON                    | Does this household grow cotton in 1995  | 0.505     | 0.062   | 0      | 1          |
| EXCHANGE                  | Natural log of the total \$ value of remittances and gifts given and received per capita per household January till September 1995 | 0.003     | 0.066   | -4.026 | 3.006      |
| INCOME                    | Net household income in \$ in 1995   | 250.964   | 23.689  | 19.941 | 6,495.847  |
| INCOMEPC                  | Net household income per capita in \$ in 1995  | 37.130    | 3.609   | 4.500  | 463.989    |
| PLOTFRAG                  | Natural log of the effective number of plots per hectare per household in 1995   | 0.381     | 0.037   | -2.507 | 3.567      |
| SHAREON                   | Share of income derived from food and cash crops in % per household  | 0.821     | 0.018   | 0.180  | 1          |
| SHARESUB                  | Share of income derived from subsistence activities per household in 1995  | 0.607     | 0.027   | 0.005  | 1          |
| STATUS1                   | Type of household by output market participation in 1993-94  | 2.860     | 0.096   | 1      | 4          |
| STATUS2                   | Type of household by output market participation in 1994-95  | 2.544     | 0.182   | 1      | 4          |
| STATUS3                   | Type of household by crop market participation in 1994-95  | 0.786     | 0.055   | 0      | 1          |
| TYPE1                     | Which type of income activities is the household undertaking in 1995?  | 2.860     | 0.106   | 1      | 4          |
| TYPE2                     | Household is participating in off-farm activities in 1995?   | 0.438     | 0.049   | 0      | 1          |
| <b>Labor Variables</b>    |  |           |         |        |            |
| ADULT                     | Number of non-dependent residents per household in mid-1995  | 5.573     | 0.330   | 1      | 15         |
| ADULTSQU                  | Square of number of non-dependent residents per household in mid-1995  | 37.262    | 4.266   | 1      | 225        |
| AGEHEAD                   | Age of household head in years in mid-1995   | 40.928    | 1.354   | 19     | 83         |
| AGEHEADSQU                | Square of age of household head in years in mid-1995   | 1,830.025 | 111.895 | 361    | 6,889      |
| AGEHH                     | Average age of household in years in early 1995  | 22.124    | 0.100   | 8.750  | 69         |
| AGEHHSQU                  | Square of average age of household in years in early 1995  | 548.877   | 48.504  | 76.563 | 4,761      |
| DEPEND                    | Number of dependent residents per household in mid-1995  | 1.888     | 0.111   | 0      | 7          |
| DEPENDRATIO               | Dependency ratio per household in mid-1994   | 0.275     | 0.016   | 0      | 1          |
| DEPENDSQU                 | Square of number of dependent residents per household in mid-1995  | 5.534     | 0.523   | 0      | 49         |
| EDUHH                     | Average number of years of education per household member in mid-1994  | 0.964     | 0.061   | 0      | 4          |
| EDUHHSQU                  | Square of average number of years of education per household member in mid-1994  | 1.510     | 0.163   | 0      | 16         |
| EDUMAX                    | Maximal number of years of effective education per household   | 3.582     | 0.213   | 0      | 12         |
| EDUMAXSQU                 | Square of maximal number of years of effective education per household   | 17.625    | 1.453   | 0      | 144        |
| EDUMUM                    | Number of years of education of the mother per household   | 0.774     | 0.159   | 0      | 7          |
| EDUMUMSQU                 | Square of number of years of education of the mother per household   | 2.333     | 0.556   | 0      | 49         |
| FEMALE                    | Number of females per household in 1994-96   | 3.472     | 0.198   | 0      | 10         |
| FEMALESQU                 | Square of number of females per household in 1994-96   | 15.219    | 1.682   | 0      | 100        |
| FEMHEAD                   | Was this a female-headed household in mid-1994?  | 0.013     | 0.006   | 0      | 1          |
| ILLNOW                    | Total number days ill per household in 1995-96   | 21.772    | 2.351   | 0      | 215        |
| ILLPAST                   | Total number days ill per household in 1994-95   | 46.066    | 10.599  | 0      | 433        |
| MALE                      | Number of males per household in 1994-96   | 3.956     | 0.183   | 0      | 11         |
| MALESQU                   | Square of number of males per household in 1994-96   | 19.638    | 1.673   | 0      | 121        |
| TIMEHARVEST               | Number of hours per month the wife spent collecting water in the harvest season in 1995  | 24.629    | 3.274   | 0      | 270        |
| TIMEHUNGRY                | Number of hours per month the wife spent collecting water in the hungry season in 1995   | 15.060    | 1.001   | 0      | 60         |
| <b>Land Variables</b>     |  |           |         |        |            |
| AREALOG                   | Natural log of cultivated area per capita in 1994-95 per household in hectare  | -1.033    | 0.089   | -3.337 | 1.065      |
| AREATOTAL                 | Cultivated and fall area per capita per household in 1994-95 in hectare  | 4.023     | 0.254   | 0.290  | 35         |
| AREATOTALLOG              | Natural log of cultivated and fall area per capita in 1994-95 per household in hectare   | -0.681    | 0.084   | -2.773 | 1.131      |
| DISTANCE                  | Distance to fields in minutes in 1995 per household  | 40.669    | 3.481   | 2      | 188.571    |
| DISTANCESQU               | Square of distance to fields in minutes in 1995 per household  | 2,312.797 | 324.291 | 4      | 35,559.180 |
| PESTHIGH                  | Do more than 75% of all types of stored food crops suffer from pests?  | 0.459     | 0.041   | 0      | 1          |
| PESTLOW                   | Do more than 25% of all types of stored food crops suffer from pests?  | 0.754     | 0.043   | 0      | 1          |
| PESTMEDIUM                | Do more than 50% of all types of stored food crops suffer from pests?  | 0.593     | 0.049   | 0      | 1          |
| RAIN                      | Proportion of cultivated area per household with lack of rain in 1994-95   | 0.296     | 0.049   | 0      | 1          |
| SOILBAD                   | Very low soil quality per household?   | 0.286     | 0.047   | 0      | 1          |
| SOILGOOD                  | Very high soil quality per household?  | 0.408     | 0.053   | 0      | 1          |

|                          |  |           |         |         |            |
|--------------------------|--|-----------|---------|---------|------------|
| TENURE                   | Are you worried about household land tenure?   | 0.522     | 0.075   | 0       | 1          |
| <b>Asset Variables</b>   |  |           |         |         |            |
| ANCESTOR                 | Does the household have ancestors who were buried locally?                                     | 0.844     | 0.041   | 0       | 1          |
| ANIMAL                   | Household owns at least one large animal in late 1992?   | 0.112     | 0.027   | 0       | 1          |
| ASSET                    | Value of assets in real 1996 US\$ per household in late 1992                                   | 166.802   | 23.127  | 0       | 2,471.327  |
| ASSETLOG                 | Natural log of value of assets in real 1996 US\$ per household in late 1992                    | 2.925     | 0.254   | 0       | 7.813      |
| AUTHORITY                | Is household head in any position of traditional or political authority?                       | 0.071     | 0.013   | 0       | 1          |
| DONATION                 | Has this household received food, seed or in-kind aid?   | 0.079     | 0.027   | 0       | 1          |
| ORIGINMAN                | Is this village the origin of the main man in the household?                                   | 0.678     | 0.049   | 0       | 1          |
| ORIGINWOMAN              | Is this village the origin of the main woman in the household?                                 | 0.652     | 0.050   | 0       | 1          |
| TOOL                     | Number tools per household in mid-1995   | 6.175     | 0.242   | 0       | 27         |
| TOOLPC                   | Number tools per capita per household in mid-1995  | 0.926     | 0.063   | 0       | 4          |
| TOOLTYPE                 | Number of types of tools per household in mid-1995   | 2.899     | 0.115   | 0       | 5          |
| <b>Village Variables</b> |  |           |         |         |            |
| INFRASTR                 | Above average complaints about economic infrastructure and trade per village                   | 0.451     | 0.122   | 0       | 1          |
| LABOR                    | Natural log of the number of hours of labor hired for farm work per village in 1995            | 7.234     | 0.188   | 5.236   | 9.680      |
| LABORPC                  | Natural log of the number of hours of labor hired per capita for farm work per village in 1995 | 1.402     | 0.184   | 0.325   | 3.399      |
| MARKET                   | Total crop sales by all village households in \$ in 1993-94                                    | 3,564.409 | 572.805 | 525.158 | 13,398.710 |
| MARKETLOG                | Natural log of total crop sales by all village households in \$ in 1993-94                     | 7.531     | 0.231   | 4.987   | 10.044     |
| MILL                     | Number of mills near household in mid-1995   | 2.242     | 0.308   | 1       | 15         |
| YIELDCOTTON              | Natural log of mean yield for cotton per village in kg per ha in 1994-95                       | 6.351     | 0.134   | 4.934   | 7.249      |
| YIELDMAIZE               | Natural log of mean yield for maize per village in kg per ha in 1994-95                        | 5.609     | 0.113   | 4.895   | 6.989      |
| <b>Control Variables</b> |  |           |         |         |            |
| PRICE14                  | Paasche price index for purchased food in late 1995 per household                              | 0.929     | 0.036   | 0.297   | 2.587      |
| PRICE15                  | Paasche price index for purchased food in early 1996 per household                             | 1.128     | 0.073   | 0.333   | 3.554      |
| PRICE23                  | Paasche price index for purchased non-food in mid-1995 per household                           | 1.050     | 0.059   | 0.510   | 2.420      |
| PRICE24                  | Paasche price index for purchased non-food in late 1995 per household                          | 0.978     | 0.051   | 0.399   | 3.212      |
| PRICE33                  | Paasche price index home produced food crops in mid-1995 per household                         | 1.044     | 0.066   | 0.456   | 2.736      |
| PRICE34                  | Paasche price index home produced food crops in late 1995 per household                        | 1.096     | 0.152   | 0.375   | 2.473      |
| PRICE35                  | Paasche price index home produced food crops in early 1996 per household                       | 1.299     | 0.208   | 0.382   | 2.618      |
| PRICEV1                  | Variance of PRICE1X  | 0.090     | 0.015   | 0.000   | 1.784      |
| PRICEV2                  | Variance of PRICE2X  | 0.058     | 0.013   | 0.000   | 1.412      |
| PRICEV3                  | Variance of PRICE3X  | 0.403     | 0.110   | 0.000   | 1.335      |
| VILLAGE111               | Does this household live in village 111?   | 0.042     | 0.030   | 0       | 1          |
| VILLAGE112               | Does this household live in village 112?   | 0.042     | 0.034   | 0       | 1          |
| VILLAGE113               | Does this household live in village 113?   | 0.039     | 0.028   | 0       | 1          |
| VILLAGE114               | Does this household live in village 114?   | 0.022     | 0.018   | 0       | 1          |
| VILLAGE121               | Does this household live in village 121?   | 0.104     | 0.091   | 0       | 1          |
| VILLAGE122               | Does this household live in village 122?   | 0.084     | 0.076   | 0       | 1          |
| VILLAGE123               | Does this household live in village 123?   | 0.169     | 0.118   | 0       | 1          |
| VILLAGE214               | Does this household live in village 214?   | 0.047     | 0.034   | 0       | 1          |
| VILLAGE215               | Does this household live in village 215?   | 0.034     | 0.029   | 0       | 1          |
| VILLAGE221               | Does this household live in village 221?   | 0.042     | 0.033   | 0       | 1          |
| VILLAGE231               | Does this household live in village 231?   | 0.035     | 0.032   | 0       | 1          |
| VILLAGE232               | Does this household live in village 232?   | 0.038     | 0.034   | 0       | 1          |
| VILLAGE312               | Does this household live in village 312?   | 0.095     | 0.086   | 0       | 1          |
| VILLAGE313               | Does this household live in village 313?   | 0.072     | 0.050   | 0       | 1          |
| VILLAGE321               | Does this household live in village 321?   | 0.082     | 0.063   | 0       | 1          |
| VILLAGE332               | Does this household live in village 332?   | 0.054     | 0.045   | 0       | 1          |

**Table 2: Sources of Income**

| % of Net Household Income in 1995 (INCOME) |                        | Non-Market Income | Market Income | Total |
|--|------------------------|-------------------|---------------|-------|
| <b>On-Farm Income</b>                      | Food Crop Income       | 59                | 6             | 65    |
|  | Cash Crop Income       | n.a.              | 17            | 17    |
|  | <b>Sub-Total</b>       | 59                | 23            | 82    |
| <b>Off-Farm Income</b>                     | Entrepreneurial Income | n.a.              | 10            | 10    |
|  | Social and Wage Income | 2                 | 6             | 8     |
|  | <b>Sub-Total</b>       | 2                 | 16            | 18    |
| <b>Total</b>                               |                        | 61                | 39            | 100   |

**Table 3: Household Income Shares in Sub-Saharan Africa**

| % of Total Income          | On-Farm Income |     | Off-Farm Income |     | Social Income |     |
|----------------------------|----------------|-----|-----------------|-----|---------------|-----|
|                            | FSP            | SSA | FSP             | SSA | FSP           | SSA |
| <b>Maximum Survey</b>      | 100            | 86  | 0               | 8   | 0             | 4   |
| <b>Mean of All Surveys</b> | 82             | 63  | 16              | 28  | 2             | 8   |
| <b>Median Survey</b>       | 88             | 63  | 12              | 20  | 0             | 16  |
| <b>Minimum Survey</b>      | 18             | 37  | 82              | 51  | 45            | 11  |

On-farm income includes food and cash crop income from home consumption and from crop sales. Off-farm income includes entrepreneurial and wage income. Social income includes remittances, transfers and donations. The three categories of income sum to give total income. The data reported under the headings "SSA" and "Mean of All Surveys" derived from 28 samples of farming households from Sub-Saharan Africa (abbreviated SSA) as calculated by Delgado and Siamwalla (1999: p. 134). Most surveys covered a single agricultural year within the period 1985-89. The other data under the headings "SSA" refer to the mean values of one survey as defined below. "Maximum Survey", "Median Survey" and "Minimum Survey" refer to the income shares for the uplands area in Gambia in 1985-86, the Natural Region IV in Zimbabwe in 1988-89 and the Sahelian Zone in Senegal in 1988-90, respectively. The data under the "FSP" headings report the largest, mean, median and smallest value in the sample.

**Table 4: Change in Crop Market Participation Status by Household**

| Estimated % of Population<br>Crop Market Participation in<br>1993-94 (STATUS1) | Crop Market Participation in 1994-95 (STATUS2) |                            |                                |                            |       |
|--|--|----------------------------|--------------------------------|----------------------------|-------|
|  | No Crop Market<br>Participation                | Sell Food<br>Crops<br>Only | Sell Food<br>and Cash<br>Crops | Sell Cash<br>Crops<br>Only | Total |
| <b>No Crop Market Participation</b>  | <b>6.0</b>                                     | 3.7                        | 1.7                            | 1.7                        | 13.1  |
| <b>Sell Food Crops Only</b>  | 8.7  | <b>8.6</b>                 | 4.7                            | 2.4                        | 24.3  |
| <b>Sell Food and Cash Crops</b>  | 0.8  | 4.6                        | <b>15.5</b>                    | 5.4                        | 26.2  |
| <b>Sell Cash Crops Only</b>  | 6.0  | 7.8                        | 10.1                           | <b>12.5</b>                | 36.4  |
| <b>Total</b>   | 21.4   | 24.7                       | 31.9                           | 21.9                       | 100.0 |

**Table 5a: SHAREON Survey Linear Regression**

| SHAREON                  | Coef.     | St Err   | t      | P> t  |
|--------------------------|-----------|----------|--------|-------|
| <b>Labor Variables</b>   |           |          |        |       |
| ADULT                    | -.0175303 | .0118692 | -1.477 | 0.148 |
| ADULTSQU                 | .0024204  | .0009244 | 2.618  | 0.013 |
| DEPEND                   | .0125307  | .0126305 | 0.992  | 0.327 |
| DEPENDSQU                | .0025772  | .0022725 | 1.134  | 0.264 |
| AGEHEAD                  | .006284   | .0050466 | 1.245  | 0.220 |
| AGEHEADSQU               | -.0000475 | .0000536 | -0.886 | 0.381 |
| ILLPAST                  | .0001988  | .0001155 | 1.722  | 0.093 |
| EDUMAX                   | .0339539  | .0102777 | 3.304  | 0.002 |
| EDUMAXSQU                | -.0043813 | .0011937 | -3.670 | 0.001 |
| EDUMUM                   | .0176925  | .0125629 | 1.408  | 0.167 |
| EDUMUMSQU                | -.0044985 | .0026637 | -1.689 | 0.099 |
| <b>Land Variables</b>    |           |          |        |       |
| AREALOG                  | .1348631  | .0211524 | 6.376  | 0.000 |
| DISTANCE                 | -.001767  | .000738  | -2.394 | 0.022 |
| DISTANCESQU              | 8.61e-06  | 4.37e-06 | 1.971  | 0.056 |
| RAIN                     | -.0573291 | .0246265 | -2.328 | 0.025 |
| TENURE                   | -.0846296 | .0244551 | -3.461 | 0.001 |
| PESTHIGH                 | .0313504  | .0146427 | 2.141  | 0.039 |
| SOILGOOD                 | -.0367615 | .0232397 | -1.582 | 0.122 |
| <b>Asset Variables</b>   |           |          |        |       |
| TOOL                     | -.0039323 | .0025538 | -1.540 | 0.132 |
| ANIMAL                   | .0735934  | .0199542 | 3.688  | 0.001 |
| ASSET                    | -.0000986 | .0000304 | -3.240 | 0.002 |
| AUTHORITY                | .0480518  | .0303493 | 1.583  | 0.121 |
| <b>Village Variables</b> |           |          |        |       |
| MILL                     | .0136944  | .0036493 | 3.753  | 0.001 |
| INFRASTR                 | .2123507  | .0261925 | 8.107  | 0.000 |
| LABOR                    | -.0103357 | .0145806 | -0.709 | 0.483 |
| MARKETLOG                | .0200332  | .0116077 | 1.726  | 0.092 |
| YIELDMAIZE               | .074847   | .0247589 | 3.023  | 0.004 |
| <b>Control Variables</b> |           |          |        |       |
| PRICE15                  | -.0971776 | .0373487 | -2.602 | 0.013 |
| PRICE24                  | .0846178  | .0405244 | 2.088  | 0.043 |
| PRICE35                  | .1714816  | .0263662 | 6.504  | 0.000 |
| VILLAGE111               | -.0507845 | .0453515 | -1.120 | 0.270 |
| VILLAGE114               | -.0732669 | .0390354 | -1.877 | 0.068 |
| VILLAGE121               | -.1461745 | .0244581 | -5.977 | 0.000 |
| VILLAGE122               | -.0271135 | .0355936 | -0.762 | 0.451 |
| VILLAGE214               | -.0333665 | .029371  | -1.136 | 0.263 |
| VILLAGE221               | -.0938319 | .0479186 | -1.958 | 0.057 |
| VILLAGE231               | .0613586  | .0244168 | 2.513  | 0.016 |
| VILLAGE312               | .2388966  | .0546979 | 4.368  | 0.000 |
| VILLAGE321               | .0708184  | .0612714 | 1.156  | 0.255 |
| VILLAGE332               | -.124287  | .036416  | -3.413 | 0.002 |
| _cons                    | .0306183  | .2308753 | 0.133  | 0.895 |

**Table 5b: STATUS3 Survey Logistic Regression**

| STATUS3                  | Odds Ratio | St Err   | t      | P> t  |
|--------------------------|------------|----------|--------|-------|
| <b>Labor Variables</b>   |            |          |        |       |
| DEPENDRATIO              | .0287958   | .0524622 | -1.947 | 0.059 |
| EDUMAX                   | 7.590794   | 3.4112   | 4.510  | 0.000 |
| EDUMAXSQU                | .8362344   | .0368466 | -4.059 | 0.000 |
| <b>Land Variables</b>    |            |          |        |       |
| AREATOTAL                | 2.574034   | .5561985 | 4.376  | 0.000 |
| DISTANCE                 | .8584758   | .0369266 | -3.548 | 0.001 |
| DISTANCESQU              | 1.000807   | .0002892 | 2.792  | 0.008 |
| SOILBAD                  | .1577242   | .1405665 | -2.072 | 0.045 |
| <b>Asset Variables</b>   |            |          |        |       |
| ANCESTOR                 | .0626775   | .03911   | -4.439 | 0.000 |
| ANIMAL                   | 37.14033   | 41.74628 | 3.216  | 0.003 |
| PESTLOW                  | .0985065   | .0822063 | -2.777 | 0.009 |
| TOOL                     | .8089222   | .0505451 | -3.394 | 0.002 |
| TOOLTYPE                 | 2.133092   | .3857646 | 4.189  | 0.000 |
| <b>Village Variables</b> |            |          |        |       |
| LABOR                    | .1352365   | .075941  | -3.563 | 0.001 |
| YIELDMAIZE               | 121.6222   | 107.1831 | 5.448  | 0.000 |
| <b>Control Variables</b> |            |          |        |       |
| PRICE14                  | .0171836   | .0332159 | -2.102 | 0.043 |
| PRICE15                  | .0131806   | .0175737 | -3.247 | 0.003 |
| VILLAGE111               | .7713355   | 1.550567 | -0.129 | 0.898 |
| VILLAGE114               | 1.115601   | 1.186605 | 0.103  | 0.919 |
| VILLAGE121               | 162.0436   | 134.7856 | 6.117  | 0.000 |
| VILLAGE123               | 108.9385   | 88.13457 | 5.798  | 0.000 |
| VILLAGE214               | 97.52673   | 216.203  | 2.066  | 0.046 |
| VILLAGE215               | 1.788877   | 2.851237 | 0.365  | 0.717 |
| VILLAGE221               | .1309925   | .214853  | -1.239 | 0.223 |
| VILLAGE231               | 1.189642   | 1.686851 | 0.122  | 0.903 |
| VILLAGE312               | 2.737442   | 4.129853 | 0.667  | 0.509 |
| VILLAGE313               | 54.29381   | 65.03203 | 3.335  | 0.002 |
| VILLAGE321               | .1761884   | .2013963 | -1.519 | 0.138 |
| VILLAGE332               | .0029133   | .004347  | -3.913 | 0.000 |

**Table 5c: SHARESUB Survey Linear Regression**

| SHARESUB                 | Coef.     | St Err   | t      | P> t  |
|--------------------------|-----------|----------|--------|-------|
| <b>Labor Variables</b>   |           |          |        |       |
| ADULT                    | -.0620192 | .014571  | -4.256 | 0.000 |
| ADULTSQU                 | .005219   | .0009563 | 5.457  | 0.000 |
| AGEHEAD                  | .0054016  | .0064104 | 0.843  | 0.405 |
| AGEHEADSQU               | -.0000262 | .0000698 | -0.375 | 0.710 |
| FEMHEAD                  | .1060473  | .0551032 | 1.925  | 0.062 |
| <b>Land Variables</b>    |           |          |        |       |
| DISTANCE                 | -.002181  | .0008438 | -2.585 | 0.014 |
| DISTANCESQU              | .0000156  | 5.18E-06 | 3.008  | 0.005 |
| PESTHIGH                 | .0345854  | .0162093 | 2.134  | 0.039 |
| RAIN                     | -.0959057 | .0212148 | -4.521 | 0.000 |
| TENURE                   | -.1028891 | .037022  | -2.779 | 0.008 |
| <b>Asset Variables</b>   |           |          |        |       |
| ANCESTOR                 | .0875478  | .0361663 | 2.421  | 0.020 |
| ASSET                    | -.0001499 | .0000218 | -6.870 | 0.000 |
| DONATION                 | .069358   | .031295  | 2.216  | 0.033 |
| ORIGINMAN                | -.0721725 | .032152  | -2.245 | 0.031 |
| <b>Village Variables</b> |           |          |        |       |
| INFRASTR                 | .3000989  | .0950152 | 3.158  | 0.003 |
| MILL                     | .0108649  | .0053901 | 2.016  | 0.051 |
| YIELDMAIZE               | .1259888  | .0515399 | 2.444  | 0.019 |
| <b>Control Variables</b> |           |          |        |       |
| PRICE15                  | -.0482654 | .0260804 | -1.851 | 0.072 |
| PRICE33                  | .1072565  | .0550026 | 1.950  | 0.058 |
| PRICE35                  | .2440533  | .0410486 | 5.945  | 0.000 |
| VILLAGE111               | -.0391956 | .0409281 | -0.958 | 0.344 |
| VILLAGE112               | -.2499654 | .1052864 | -2.374 | 0.023 |
| VILLAGE121               | -.1738759 | .1001921 | -1.735 | 0.091 |
| VILLAGE122               | -.0038679 | .0928867 | -0.042 | 0.967 |
| VILLAGE214               | -.3142226 | .0849659 | -3.698 | 0.001 |
| VILLAGE215               | -.0839465 | .0652356 | -1.287 | 0.206 |
| VILLAGE221               | -.1436878 | .0974528 | -1.474 | 0.148 |
| VILLAGE231               | -.1358108 | .0361795 | -3.754 | 0.001 |
| VILLAGE232               | -.2390645 | .0904007 | -2.644 | 0.012 |
| VILLAGE312               | .1165941  | .0632936 | 1.842  | 0.073 |
| VILLAGE313               | -.2766398 | .1012645 | -2.732 | 0.009 |
| VILLAGE332               | -.3427917 | .0532544 | -6.437 | 0.000 |
| _cons                    | -.4481974 | .3850826 | -1.164 | 0.252 |



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