Using Rural Household Income Survey Data to Inform Poverty Analysis: An Example from Mozambique

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Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006

The authors gratefully acknowledge the financial support of USAID Mozambique and USAID Washington (EGAT and Africa Bureau) through the Food Security III Cooperative Agreement and the financial and programmatic support of the Ministry of Agriculture in Mozambique.

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Abstract. This paper demonstrates that income survey data can be very informative in explaining the variation across households in the incidence and severity of absolute poverty using a rural household income data set for Mozambique. Results from regression analysis are used to simulate the impact of alternative interventions on rural poverty. These simulations show the importance of agricultural development variables in poverty reduction scenarios that are usually dominated by educational and demographic considerations when consumption poverty is the focus of analysis. Complementarities in the insights gained from consumption expenditure and income surveys justify the collection of both types of information.

JEL Codes: C21, I3, O13, O2, Q18.

Keywords: Income poverty, consumption poverty, household surveys, agricultural development, Millenium Development Goals.

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1. Introduction

Research on poverty has been a major growth area for social scientists over the past fifteen years. The adoption by UN member countries of the Millennium Development Goals, the first of which calls for halving the incidence of poverty and hunger by 2015, has underlined the importance of such research. The central role of National Poverty Reduction Strategies as a "contract" between international aid donors and host countries has increased the policy profile of such analysis. Because the incidence and severity of poverty are more accurately estimated through consumption expenditure surveys (Deaton 1997; Grosh and Glewwe, 2000) the use of income data to inform poverty analysis, while increasing, is still comparatively rare.

Although the problems in measuring income poverty are well known (but are probably inadequately documented), it is less appreciated that reliance on consumption expenditure to proxy for income may, if wrongly interpreted, discriminate against agricultural development. The determinants of rural consumption expenditure are usually dominated by demographic and educational variables (Datt et al. 2000; Datt and Joliffe, 1998). Considerations that relate to agricultural development are often secondary, giving the erroneous impression that investing in education is paramount and that agriculture is relatively unimportant. The relatively distant link between consumption expenditure and the scanty agricultural data that are collected in Living Standard Measurement Surveys greatly reduces the scope for agricultural economists to contribute valuable analysis that can inform strategies to achieve the first Millennium Development Goal.

In this paper, we seek to demonstrate that income survey data can be very informative in explaining the variation across households in the incidence and severity of absolute poverty using a rural household income data set for Mozambique. Analysis of the sources of variation can be used to simulate the impact of alternative agricultural interventions or strategies on rural poverty. Complementarities in the insights gained from consumption expenditure and income surveys may justify the collection and analysis of both types of information, especially in Sub-Saharan Africa, the one region of the world where the incidence of poverty is increasing (United Nations, 2005).

2. Data and Methods

The analysis is based on a Ministry of Agriculture survey of a nationally representative sample of rural households (called the *Trabalho de Inquérito Agrícola*, commonly known as "TIA") covering the agricultural year 2001-2002. The TIA complements the *Inquerito do Agregado Familiar* (IAF) undertaken by the Ministry of Plan and Finance for both rural and urban populations. The IAF measures household consumption expenditure; the TIA provides data on household income. Official poverty estimates are based on the IAF (MPF, 2004).

The analytical steps we apply to these data are 1) measurement of household income; 2) estimation of poverty incidence and severity; 3) regression analysis to estimate reduced-form equations of the impact of different variables on poverty; and 4) simulation of development scenarios. A detailed description of methods is given in Walker et al., 2004.

Rural incomes are calculated from TIA data as the value of own production and off-farm earnings less paid out costs. Income sources include (1) net crop income, (2)

livestock income, (3) off-farm self-employment, net small-business income, (4) off-farm self-employment, resource-extraction income, (5) off-farm agricultural wage income, (6) off-farm non-agricultural wage income, and (7) net remittance income.

We do not develop separate poverty lines for income. Instead, we use the consumption expenditure poverty lines that are based on the caloric intake needed to satisfy recommended dietary allowances (Datt et al., 2000). These poverty lines have recently been updated for six rural regions of Mozambique. They range from about 22 to 55 cents per person per day in US dollars in 2002-2003 (MPF, 2004).

We quantify the incidence and the severity of income poverty with the head count index and the squared poverty gap (Ravallion, 1993). The former is a dichotomous 0-1 variable; the latter is defined along an interval bound by 0 and 1. Households with per capita income equal to or above the poverty line receive a value of 0. Higher values indicate more "severe" poverty.

The income poverty simulations are based on reduced-form regressions of a comprehensive set of independent variables from the TIA 2002. The head count measure of poverty is estimated directly in a dichotomous-variable logit framework with households falling below the poverty line assigned a one. The variation in the severity of poverty is estimated using a tobit regression model with a lower limit 0 and an upper limit 1 circumscribing the interval of the squared poverty gap. Independent variables reflect demographic factors (gender, household size and composition, education), household assets (land, cashew and coconut trees, livestock, and equipment), access to information, technology and organizations, community attributes and infrastructure, exposure to risks and agro-ecology. For several continuous variables (e.g., land ownership, household size, education) we employ frequency thresholds rather than

assuming a particular functional form. This stepwise classification of the independent variables is equivalent to a more flexible piecewise functional form and facilitates the construction and interpretation of the scenarios.

Regression analysts must make judgments about the degree of endogeneity or exogeneity of potential explanatory variables. We excluded from our regression several potential variables because of concerns about endogeneity. These include growing of horticultural crops, use of purchased inputs, hiring of labor on farm, and working off the farm. All these variables contribute to income but also may reflect decisions based on previous income results. In other cases, we re-formulated variables to avoid endogeneity problems. For example, our land variables are based on owned land, not area cultivated. We include number of fruit trees but not decisions to produce fruit or vegetables. Crop diversification is measured at the community level, not the household level.

The simulation methodology uses predicted estimates generated from the reduced-form regressions. No attempt is made to structurally model income generation and carry out a "formal" simulation exercise. Because the results of the simulation are sensitive to how the model was specified, they are illustrative and indicate rough orders of magnitude. Only variables with statistically significant coefficients were selected as candidates for the scenarios.

3. Results and Discussion

The headcount incidence of poverty is 82% with a 95% conference interval from 80 to 84%. Had retail purchase prices been available to value home-produced, on-farm consumption instead of the sales prices reported by producers, the estimates of poverty

would be lower (the majority of households are net consumers). Most sales took place at or shortly after the harvest; therefore, sales prices are also likely to be seasonally low.

The frequency distribution of the squared poverty gap is charted in Figure 1. The mean estimated squared poverty gap is large at 0.35. The outstanding feature of Figure 1 is the flatness of the empirical distribution of the squared poverty gap, suggesting that assessment of welfare is not sensitive to the location of the poverty line.

Our logit and tobit estimates on the incidence and severity of poverty are presented in the first and second columns of Table 1. Poverty is associated with higher positive values in the dependent variable in both columns.

Estimated coefficients of the squared poverty gap are considerably more sensitive to small changes in the independent variables than those related to the headcount index which is a blunt measure of human welfare. For example, women-headed households are significantly poorer than male-headed households from the perspective of the squared poverty gap, but widowhood is not a significant correlate of the incidence of poverty.

Similar to regressions on the natural logarithm of consumption expenditure, household demographic and educational variables emerge as some of the strongest correlates in Table 1. (The per capita basis of measuring either consumption or income poverty guarantees that changes in family size and composition will strongly affect the incidence and severity of poverty). But several variables related to agricultural production are also significant correlates of poverty particularly the squared poverty gap. Increasing farm size and number of fields are highly correlated with reductions in the severity of poverty. The ownership of different types of assets also plays an important role in dampening severe poverty. Several of the community infrastructure variables, such as electricity and input supply stores, are associated with lifting rural households out

of severe poverty. Communities more prone to plant and disease risk are characterized by more severe poverty.

The poverty simulation scenarios are described in Table 2 together with the estimated results for the severity of income poverty in the form of the % change in the squared poverty gap index. Of the 13 scenarios in Table 2, the first two pertain to education, and the last two are demographic. These educational and demographic scenarios provide an order of magnitude reference for the nine agricultural scenarios.

The base simulation with the independent variables set at their present levels generates a predicted level for the squared poverty gap of about 0.35, reflecting a high level of income poverty. This level is significantly higher than what is commonly predicted for consumption poverty (Datt and Joliffe 1997; Datt et al. 2000). For that reason, the impact of the scenarios on income poverty ranging from about 1 to 15% in Table 2 are substantially smaller than changes of 25 to 40% commonly reported for consumption poverty. Therefore, even a small reduction in income poverty should be associated with a relatively large gain in economic welfare.

In contrast to earlier poverty simulations for Mozambique based on consumption expenditure data (Datt et al., 2000); several of the agricultural scenarios compete favorably with the education scenarios. In particular, the farm-size growth and diversification (scenario 6 in Table 2) is associated with a 14% reduction in poverty. At this stage in Mozambique's development, policies and investments that promote more differentiation of the agricultural sector resulting in more medium-sized farms can lead to favorable poverty consequences. Opening up more cropping opportunities (scenario 7) through market and infra-structural improvement is also associated with substantial scope for poverty reduction.

One of the more interesting comparisons in Table 2 is the contrast between scenarios 3 and 4. The lack of differentiation in the smallholder sector is a hard reality limiting the prospects for agricultural development in Mozambique. Only 3-4% of the households cultivate more than 5.0 ha. We show that "growing" the commercial smallholder sector will be accompanied by sizeable reductions in income poverty. In scenario 3, graduating the medium-size group of 1.75-5.0 ha to the largest group of more than 5.0 ha generated about 3-4 times more poverty-reduction impact than shifting the smallest land-owning group (less than 0.75 ha) to the next level (scenario 4). With so much income poverty and so little differentiation in the agricultural sector, a potential negative trade-off between growth and relative inequality does not emerge at this stage in Mozambique's rural development.

The large poverty-reducing impact of intensifying chicken production is the most surprising result in Table 2 (scenario 10). About two thirds of the farm households are involved in this scenario, and the coefficient on households with 30 or more chickens is one of the largest in Table 1. This result is not about having 30 or chickens per se, but it is about behaving in the same manner with households that now have 30 or more chickens. Maintaining a flock of 30 or more chickens takes considerable effort in rural Mozambique. Newcastle disease is endemic, and chickens are often used to smooth seasonal consumption to buy maize during the hunger season.

4. Conclusions

In contrast to analysis based solely on consumption expenditure surveys, poverty simulations based on detailed rural household income data clearly show that, for Mozambique, agricultural development can have an important impact on achieving the

Millennium Development Goal of halving the incidence of poverty and hunger. This brief excursion into the analysis of absolute poverty in rural Mozambique does not exhaust the potential for comprehensive income data to contribute information for agricultural development. For example, scenarios of technological change can also be evaluated from the perspective the squared poverty gap with an eye towards priority setting for national agricultural research, or factored into ex-post evaluation of agricultural research. Recognition of the potential value of household income estimates seems to be increasing, and Mozambique is now investing in a panel sample that canvasses income-related data on all the households included in the TIA 2002.

Summing up, analysis of rural household income data can provide important additional and complementary insights into the potential contribution of agriculture to poverty reduction. Consideration should be given to the collection and analysis of both income and consumption expenditure data to inform rural poverty reduction strategies. As more countries in East and Southern Africa invest in comprehensive rural income surveys the stage will be set for a more formal comparison of stylized facts and development implications not only for the region but also for a more structured understanding of the differences between consumption and income poverty within each country.

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Figure 1. The Frequency Distribution of the Severity of Rural Poverty in Mozambique in 2001-2002

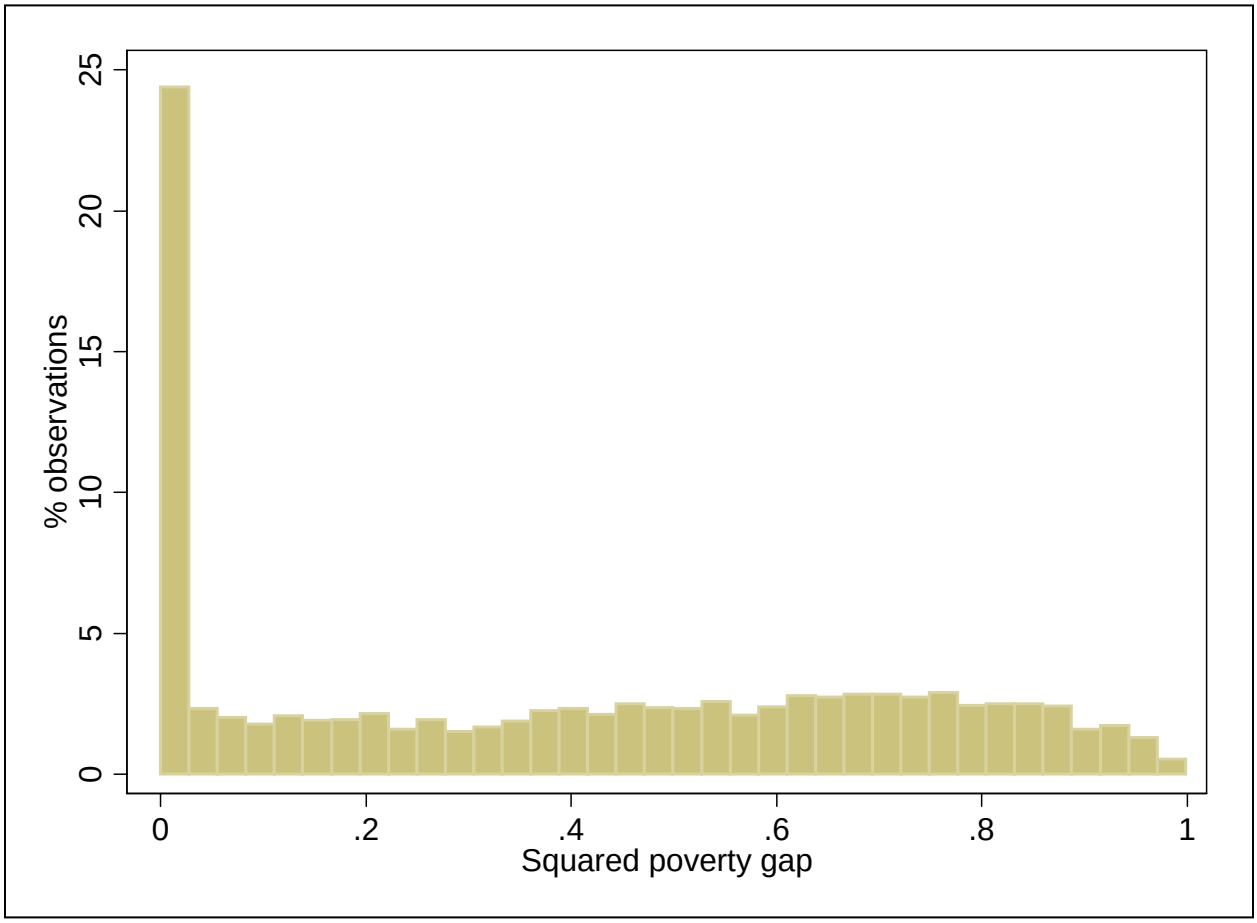

Table 1. Determinants of the Incidence and Severity of Poverty (Logit and Tobit estimates in US$[1])

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

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

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

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

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

Table 2. Changes in the Severity of Rural Income Poverty by Scenario

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