FOOD SELF-SUFFICIENCY, FERTILIZER USE, AND ACCESS TO FORMAL CREDIT: A TEST OF THE RELATIONSHIPS ON SMALL FARMS IN ETHIOPIA

by

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Credit: A Test of the Relationships on Small Farms in Ethiopia

Self-sufficiency in food production is often an important
objective for resource poor farmers in developing countries.
This may be this case in the Areka area of southern Ethiopia
which has a population density of 401 persons per square
kilometer and where farm size averages around one hectare
(Getahun Degu, et al). An importance consideration for this area
is the identification of policies that can be implemented in the
near term to increase household food production. In this regard,
the relationship between self-sufficiency in food production and
fertilizer use and access to formal credit markets is
investigated in this paper.

Fertilizer is an important input for increasing crop
productivity. A factor of major importance in determining
whether farmers will use fertilizer in sub-Saharan Africa is
believed to be access to an affordable supply of credit
(McIntire, and Beyene, et al). Does access to credit increase
the odds that fertilizer will be used and does the use of
fertilizer improve the odds for achieving household food self-
sufficiency? We provide empirical insight into these and other
important questions using household level data. The results of
this study should be of use in the design of research for the
development of policies to increase household food production
through fertilizer use in other areas of Ethiopia and in sub-
Saharan Africa.

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Area of Study and Research methods

The data used in this study were taken from a 1989 baseline survey of 160 households in the Areka area of southern Ethiopia.

The relationship between self-sufficiency in food production and use of fertilizer and access to a formal credit markets is examined, first, by determining factors that are associated with self-sufficiency and then, secondly, by determining factors associated with fertilizer use. The following model was identified to investigate for household food self-sufficiency.

$$\ln(S/(1-S)) = b + B_1 X_1 + B_2 X_2 + B_3 X_3 + B_4 X_4 + B_6 X_6 + B_8 X_8 + B_7 X_7 + B_8 X_8 + B_9 X_9 + u$$

where:

S = probability that self-sufficiency will be attained
X_1 = family members in household
X_2 = farm size in timad (0.25 hectare)
X_3 = fertilizer use dummy (yes = 1, no = 0)
X_4 = number of coffee trees
X_6 = number of enset plants
X_8 = number of livestock owned and shared
X_7 = black soil dummy (black = 1, otherwise = 0)
X_8 = red soil dummy (red = 1, otherwise = 0)
X_9 = land tenure dummy (own = 1, share crop and own = 0)
u = error term.

The fertilizer use decision was modelled as

$$\ln(P/(1-P)) = a + A_1 Z_1 + A_2 Z_2 + A_3 Z_3 + A_4 Z_4 + A_6 Z_6 + A_8 Z_8 + A_7 Z_7 + e$$

where:

P = probability that fertilizer is used
Z_1 = farm size in timad
Z_2 = number of coffee trees
Z_3 = number of livestock owned and shared
Z_4 = land tenure dummy (see X_9 above)
Z_6 = household head education in years
Z_8 = use AID bank credit dummy (credit = 1, otherwise = 0)
Z_7 = off-farm income in birr (1 birr = USD1)
e = error term.

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Because the dependent variables in the above equations are binary, a logistic model estimator was used in estimation (see Maddala). The Bs and As are the parameters to be estimated.

Results

Crop production in the Areka area occurs twice per year, coinciding with the bimodal rainfall pattern. The most common crops produced in both seasons are maize (85 percent of households), beans (48 percent), sweet potatoes (50 percent), teff (38), and enset (76 percent). Coffee, an important cash crop, was produced by 83 percent of the households. Teff is an important local cereal grain. Enset is a banana plant whose stem core is used as a food. It is considered the most important food security plant in the highland areas of southern Ethiopia.

Household Food Self-Sufficiency

Only 30 of the 160 households surveyed considered themselves to be generally self-sufficient in food production during 1989, a year of normal rainfall. In actuality, a larger number of households may have been self-sufficient in food production as 76 and 37 percent of households indicated they earned income from the sale of crops and livestock or livestock products, respectively. Aside from the need to earn cash to make repayments on loans and purchase household and personal essentials, all households needed cash for the payment of taxes imposed by government. As used here, then, household food self-sufficiency is defined in terms of a household's food production after necessary farm commodity sales.

Households engaged in a variety of tasks to alleviate the food shortage problem, which is usually serious during the first six months of the year. Causal employment was the most frequently used method with 35 percent of farmers engaging in some type of employment. For those engaged in employment the average earning was birr 131 per year (2 birr = USD1). Eight percent of the farmers had livestock sales and a further 4 percent sold livestock products. Governmental food assistance was used by 14 percent of households. Eighteen percent of the households had combinations of the above and 20 percent gave no response. There was no evidence that households sold higher valued food crops in order to earn income to purchase a larger quantity of a lower valued food commodity. No household indicated that food crops were sold to alleviate a food shortage problem.

The estimates of the model for self-sufficiency are shown in Table 1, column 1. The estimated relationship is significant when using the log-likelihood ratio test. Four of the 9 independent variables were significant. The parameter estimates are interpreted as the natural log of the odds being in favor of a household being self-sufficient in food production for a unit change in an independent variable, holding the values of the remaining independent variables constant.

The variables, number of family members in the household and the black and red soil dummy variables were significant with a negative sign. For the family variable, a one member increase in

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household size resulted in a change in the odds of the household

being self-sufficient in food production from an even chance to a

less than even chance odds of 5 to 4. (Note that the natural

anti-log of the parameter -0.20 is 0.82, which is an odds of 1 to

0.82, or when putting into whole integers is approximately an

odds of 5 to 4). This result is as expected as larger families

had proportionally more children than smaller families and the

contribution of children to food production is minimal.

The black and red soil type dummy variables are interpreted

with respect to the omitted brown soil type dummy. The odds of

being self-sufficient was 7 to 1 and 5 to 1 when production

occurs on black and red soils, respectively, when compared to

brown soils. While soil analysis are incomplete, the brown soil

type is considered to be more fertile than both the black and red

soils. Black soils are typically nitosols located in or close to

the valley bottoms while red soils are typically located on the

highly eroded steep slopes. Soils brown in color are also

located on slopes, but they are believed to be less eroded than

the red soils.

The fertilizer use dummy variable was the only variable

found to be positively directly associated to food self-sufficiency. For

households using fertilizer, the odds of being self sufficient

was approximately 2 to 5 (i.e., a better than even chance) when

compared to households not using fertilizer. The odds may have

been more in favor of self-sufficiency if fertilizer was

available on time and farmers could have purchased the amount of

fertilizer desired, two problems cited by farmers. The quantity of fertilizer used per household was not recorded. However, 26 percent of households used fertilizer on maize, 29 percent on beans, 5 percent on sweet potatoes, and 60 percent on teff.

The variables found to be not significant in explaining self-sufficiency in food production were farm size, number of coffee trees, number of enset plants, and land tenure status. The result for coffee suggest the production of this perennial cash crop, which can occupy a large area of land, does not decrease the odds of attaining food self-sufficiency. The reason for this finding is, perhaps, best explained by farmers' coffee management practices. Fifty-eight percent of the farmers practiced intercropping of food crops underneath coffee trees. The crops intercropped were maize, sweet potatoes, and beans.

This result can have important implications for coffee tree management policies in other African countries. In several countries of eastern Africa farmers are not permitted to intercrop underneath coffee trees because it is believed that both the yield and quality of the coffee will suffer. As a result of this requirement, small farmers are forced to make a long term land allocation decisions between coffee and food crops. If land is allocated to coffee, farmers loose the flexibility to allocate scarce land resources to food production as household food needs arise. And perhaps more importantly, farmers are forbidden by government to uproot coffee trees.

In Ethiopia, farmers enhance their flexibility in land use –

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- and probably overall food security -- by planting coffee trees further apart, allowing for greater opportunity for food production without eliminating the potential for cash crop production. Farmers in other eastern African countries could benefit from policies that allow the intercropping of food crops with coffee.

The result for the enset plant was unexpected. Enset is normally used as the crop to insure food needs when all other crops fail. One probable reason that it was not found to be significant was that enset plant stocks were severely depleted in the mid-1980s from over consumption because of drought.

Fertilizer Use

Sixty-two percent of the 160 households surveyed used fertilizer. Almost exclusively, the fertilizer used was DAP. A shortage of cash or credit and the unavailability of fertilizer on time were the most important reasons why farmers did not purchase fertilizer, or when purchased, purchase larger quantities. Only 3 percent of farmers indicated that they did not need to use fertilizer.

The parameter estimates for the fertilizer-use model are shown in Table 1, column 2. The estimated relationship was significant using the log-likelihood ratio test. Four of the 7 independent variables were significant. When credit from the government owned AID Bank was taken, the odds of using fertilizer was 1 to 20 in favor of a household using fertilizer. Obtaining bank credit is thus an important determinant of fertilizer use.

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Thirty-four percent of the 160 households surveyed obtained AID Bank credit (see the Agricultural and Industrial Development Bank citation for a description of AID Bank loan terms). However, the amount borrowed per household is not known. Seventy-six households indicated the AID Bank loan was for the purchase of fertilizer while the remaining households used the loan for both seed and fertilizer. The most important reason households (53 percent) did not obtain a bank loan for the purchase of fertilizer was their belief that they would be unable to make repayment. Twenty-one percent of the households were not familiar with the credit system, and a further 11 percent indicated that formal bank credit was unavailable to them. Thirteen gave combinations of the above as reasons for not taking credit while 2 percent indicated that they did not want credit.

All of the 106 households that did not obtain AID Bank credit obtained credit from other sources, mainly from relatives, neighbors, and friends. Only 11 percent of these households obtained credit from money lenders and merchants. The amounts borrowed from these sources are not known. Of the 54 households borrowing from the AID Bank, only 2 borrowed from other sources.

The variables land tenure status and amount of off-farm income were negatively related to fertilizer use. The odds of households using fertilizer decreased to 3 to 1 for the group that owned their land when compared to the group that had both own and sharecropped land. However, for the 58 percent of households that used a sharecropping arrangement for at least

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some of their cropped area, 71 percent of the landlords provided all of the fertilizer. In return, the landlord received 50 percent of the crop. These results indicate that sharecropped land was more likely to have fertilizer applied than land which is owned by the household. However, recall from the earlier results that the land tenure status variable was not significant in explaining household food self-sufficiency.

For the off-farm income variable, the odds of using fertilizer was calculated as 1 to 0.99 for a one birr increase in off-farm income earned. When considered over a larger number of birr the odds that a household would use fertilizer would substantially decrease. Off-farm employment was also negatively correlated with households that where self-sufficient in food. Evidently, households that engaged in off-farm employment had made the decision to secure at least part of their food needs from wage income rather than rely on the use of fertilizer to increase crop yields. There was no evidence to suggest that labor supplies going to off-farm employment contributed to diminished food self-sufficiency. The need to raise cash to pay taxes is also believed to have contributed to engagement in off-farm employment activities as all households were required to pay taxes. Overall, the average tax per household was birr 60.

The variables farm size, number of coffee trees, and number of livestock owned and shared were not significant. Large farms were not more likely to use fertilizer than smaller farms. Even though coffee is an important cash crop, the estimated result for

this variable suggests that income earned from coffee was not necessarily being used for fertilizer purchases. It was not known if fertilizer was used on coffee trees or on the annual food crops intercropped with coffee. Indirectly, the result also suggests that households with coffee trees were not more likely to receive an AID Bank loan when compared to households with no or few coffee trees.

Conclusions

Self-sufficiency in food production of rural households in the densely populated, highland area of Areka located in southern Ethiopia is studied in this paper. Only 30 of the 160 households surveyed were found to be self-sufficient in food. Using a modeling effort, a direct relationship is established between food self-sufficiency and fertilizer use and fertilizer use and access to formal government sponsored credit. These results thus suggest the odds for household food self-sufficiency can be improved if farmers are provided with a source of formal credit.

The production of the cash crop coffee did not reduce the odds of being self-sufficient in food. One probable reason is that farmers are allowed to produce food crops under coffee trees. This finding can have important policy considerations for other countries in eastern Africa that currently prohibits intercropping with coffee. Small farmers in these countries could benefit in terms being able to produce larger quantities of food, while at the same time enhancing their overall food security situation by producing a cash crop..

Table 2. Parameter Estimates for Logit Model for Self-Sufficiency and Fertilizer Use in, Areka, Ethiopia 1990[a]

Variable	Self-sufficiency Parameter	Use fertilizer Parameter	Variable mean
Number in household	−0.20 (5 to 4)[b] (2.60)	−	7.28
Farm size in timad[c]	0.02 (0.12)	0.13 (1.03)	2.91
Fertilizer use dummy	0.93 (2 to 5) (1.81)	−	0.63
Number of Coffee trees	0.01 (0.61)	−0.01 (0.68)	25
Number of enset plants	0.01 (1.34)	−	51
Head of livestock	0.12 (1.13)	0.18 (1.26)	2.11
Black soil dummy[d]	−1.93 (7 to 1) (3.44)	−	0.46
Red soil dummy	−1.59 (5 to 1) (2.80)	−	0.40
Land tenure dummy[e]	0.33 (0.70)	−1.17(3 to 1) (2.80)	0.43
Household head educ. (yrs)	−	0.13 (0.95)	0.83
Use AID bank credit dummy[f]	−	3.02(1 to 20) (3.91)	0.34
Off-farm income (birr)[g]	−	−0.01(1 to .99) (2.08)	46
Log-likelihood ratio	−63.8	−78.9	

[a] Dependent variable for self-sufficiency model is 1 if self-sufficient in food crop production and zero otherwise and for the fertilizer use model is 1 if fertilizer is used and zero otherwise.
[b] The odds of a household being self-sufficient in food production or using fertilizer for a one unit increase in the independent variable. An odds of 5 to 4 is less than an even chance.
[c] One timad is equal to 0.25 hectare.
[d] The brown soil color variable was omitted.
[e] Variable equal 1 if land is family owned and zero if part of the land area is share cropped.
[f] Variable equal 1 if credit was received and zero otherwise.
[g] One birr is equal to USD0.50.

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