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OFF-FARM INCOME AND THE FARM HOUSEHOLD

THE CASE OF KENYAN SMALLHOLDINGS

von

Kees BURGER, Amsterdam

1 Introduction

Many farms in developing countries are self supporting in food and the food produced is largely used for consumption on the farms. In addition, crops may be grown with a view to selling them for cash. This provides the family with the means to purchase non-agricultural items such as oils, textiles, radios and inputs such as fertilizer or to pay taxes or school fees.

Such distinction between food crops retained at the farm, or cash crops that are sold, would be insignificant in economic terms if for both types of crop a regular and reliable market would be available. In that case, all crops could be classified as cash crops; and even if they would not be sold but consumed on the farm their value would equal the market value.

The distinction is important when food cannot reliably be obtained or sold in the market. If a food market is absent a farm has no choice and should grow its own food. A more common case is that food can be sold and purchased, but only at fairly high costs, due to trade margins, travel costs and due to the shadow costs connected with the unreliability of the market. A rational choice in such circumstances is to grow food for home consumption, and to produce either food or another crop for the market in order to meet the needs for items that require cash.

Instead of growing crops for the market, a household may allocate its labour directly to cash earning employment. This can be off-farm employment, for persons that continue to live on the farm, or employment further away, involving migration of a household member. Allocation of labour in this direction might have costs in terms of reduced agricultural production, due to reduced labour input. On the other hand, the reduced labour input can be compensated by the input of goods and services that can be bought with the money earned. In particular, labour can be hired if cash money is available.

This is not the only type of effect that can be expected. Off-farm employment might lead to reduced production of cash crops, if cash has diminishing utility. On the other hand, as COLLIER and LAL (1980) have stressed, cash income might have the opposite effect of enlarging the opportunities for households to grow cash crops. This would be so, if these crops are very profitable but require cash inputs for initial investments such as seedlings, or as regular inputs like pesticides.

Off-farm income may also affect the input of family labour. On the one hand, any reduction in labour input into farm work might need compensation, on the other hand the extra income could enable the household to reduce its efforts and enjoy more 'leisure'.

This paper focuses on the effects that off-farm income has on the farm household. Does the cash income change the use of external inputs; is the supply of family labour affected; does it have an effect on the cropping pattern? These are the questions that we try to answer, on the basis of data from a survey held in Kenya and Tanzania by David BEVAN, Paul COLLIER and Jan Willem GUNNING in 1982, and reported in BEVAN et al. (1989). The Kenyan part of the sample has 783 farm households from Central Province and Nyanza.

The next section investigates which off-farm earnings can be considered as truly predetermined. This is a prerequisite for the subsequent analysis in which off-farm income is used as explanatory variable.

2 Off-farm employment and income

The off-farm sources of income for the households consist of remittances from family members that have migrated to the city, and of income generated by off-farm activities of residential household members. Three types can be distinguished: non-agricultural wage jobs, own businesses, and agricultural employment on smallholdings or estates. In general, payments in the former two categories are highest, on average 36 Kenyan shillings per day in wage employment, against 12 sh per day in agricultural work. Returns to activities in own businesses appear to be substantial with earnings per day averaging at 124 sh for men, and 35 for women.

These daily earnings are high, when compared to the usual earnings from agriculture. Average gross earnings in (own) agriculture range between 6 sh per working day for cassava and 12 for the main staple crop maize, to 18 for coffee, 24 for pyrethrum and 72 for those able to grow sugar cane. The average farm has daily gross earnings of about 12 sh per day.

The rational choice for farm family members would be to take up these highly remunerative off-farm jobs wherever possible. Access to wage employment is restricted, however, by the requirements as to education and experience. These types of restriction are reported in the questionnaire for 80 % of the wage jobs. Wage jobs that do not require training or education tend to pay only some 15 sh per day.

Entry into business, and especially the more remunerative types, is restricted as this normally requires investments, credits or liquid assets to start with.

Hence, for these two types of off-farm employment it can safely be assumed that such jobs are accepted whenever possible and income from these occupations can be considered as predetermined vis-à-vis the choice on annual crops, inputs to be used, labour allocation in this year etc. In addition, income from remittances can be assumed given. Income from agricultural off-farm work should not be taken as predetermined because their earnings per day are quite comparable to those generated by the farm itself. It may well be that these jobs are only taken up by those that do not have sufficient employment on their own farm, but are unable to take up more remunerative occupations, or to migrate. This is substantiated by estimates in APPLETON et al. (1991), who report (in their Table 3.5) strong effects of education on the choice for wage employment, whereas this has hardly any impact on the choice for off-farm agricultural work.

3 The use of external inputs

Cash income can be used to pay for fertilizer or inputs like hired labour, but this money is also needed for the purchase of consumer goods, such as oil, textiles and occasionally schooling. Should there be a trade-off between the two types of use made of the limited amount of money available? In standard models, that assume the existence of markets for all outputs, there would be no such trade-off. The relevant consideration in these models is whether the monetary returns to the use of fertilizer equal the costs.

There are two reasons to deviate from this standard case. One reason is the subsistence environment, in which food is not sold in the market. Use of fertilizer for the production of food crops does not yield monetary returns in this case and the relevant considerations involve the utility, attached to the consumption of food, and that of the consumption of items that could be bought for the money. The second reason has to do with the aspect of time. In the absence of credit markets, the eventual returns from the use of fertilizer, even if they are monetary, require cash expenditures well in advance of the harvest time. In this particular period, the choice may be not the use money for purchasing fertilizer but for other end-uses, if the utility of the latter exceeds the utility attached to the (uncertain) future extra production and earnings.

The case of the first reason can be represented in a model as follows.

Let the utility be given by

$$u = u(cons, food, leis)$$

and

$$food = f(TIME-leis, fert, land)$$
$$cons = CASH-fert$$

CASH, TIME are predetermined

Here, cons stands for the consumption of purchased consumer goods, food is consumption and production of food, and leis is the amount of time not spent on food production (total time available is TIME). Cash income is kept exogenous and equal to CASH. The purchase of consumer goods could equal CASH, but must be less if cash is used to buy fertilizer.

First-order condition for an internal optimum for fert are

$$-u_1 + u_2 f_2 = 0$$

or

$$f_2 = u_1/u_2$$

where u_i or f_i refer to the derivative with respect to the i-th argument.

Assume that at fert = 0, the ratio of marginal utilities at the right-hand side is defined. If some infinitesimal quantity of fertilizer is used, f_2, the marginal physical product of fertilizer is positive, and assumed to be defined. At increasing levels of fert, f_2 will normally go down, whereas u_1 may go up (due to less cons being used), and u_2 tends to go down (due to more use of food). Hence, the RHS will go up when fert goes up. If f_2 was initially greater than the RHS ratio, there will be some value at which both sides are equal, but if, at fert = 0, f_2 is less than the RHS, no fertilizer will be used:

$$f_2 < u_1/u_2; \text{ fert} = 0$$

If CASH would go up, at fert = 0, the consumption of purchased goods increases, u_1 goes down, so that the possibility of the equality being met becomes more likely.

The model for case 2 can be similar. Here, no fertilizer would be used because the attractiveness of extra period-2 consumption is insufficient to allow reduced period-1 consumption. Allowing for some substitutability between consumption in the two periods, the utility function has cons1 and cons2 as arguments, next to 'leisure'.

Let

$$u = u(cons1, cons2, leis)$$

$$cons2 = f(TIME-leis, fert, land)$$
$$cons1 = CASH-fert$$

CASH and TIME are exogenous.

Fertilizer will not be bought and used in period 1, if at fert = 0,

$$f_2 < u_1/u_2,$$

which can be the case if marginal physical product of fertilizer is low, and relative marginal utility of consumption in the first period is high. Again, increased CASH would make the use of fertilizer more likely.

4 Evidence on the use of external inputs

The aggregate of food crops which is considered here is a collection of crops dominated by maize and beans, but otherwise quite diverse for the various farms. Within 'maize' a distinction between hybrid and traditional maize can be made, the former requiring more purchased inputs, notably seed, but often also fertilizer, whereas local maize uses relatively large amounts of hired labour for ploughing. A change in the use of inputs should be interpreted as also including a change in the composition of the aggregate.

Estimates reported here are Tobit estimates, that take truncation at zero into account.

$$HL = -800^* + 29.4^*af - 0.47^*daysm + 0.35^*daysf + 0.018^*yxm + 0.046^*yxf + 0.037^*remit$$

$$F = -330 + 13.2^*af + 116^*ac + 21^*educ + 0.003\,yx$$

$$Sd = -4 + 11.9^*af + 28.9^*ac + 4.2^*educ + 0.0004\,yx$$

with the restrictions that HL, F and Sd are non-negative.

Here, HL is hired labour hours, F is fertilizer (in sh), af denotes the area under 'food' in acres; daysm and daysf indicate the days of adult males and females, available on the farm, respectively; yxm and yxf denote the predetermined off-farm income in Kenyan shillings earned by men and women, respectively; remit are the remittances and yx is the sum of these three income variables, all expressed in Kenyan shillings; educ indicates the level of education of the household's head; ac the area in acres under coffee or tea; Sd, in the third equation, represents purchased seeds in shillings. Asterisks (*) indicate that the coefficient is significantly different from zero at the 10 % level.

Hired labour is used by 176 out of 718 farms, fertilizer by 299 farms and purchased seed by 473 farms. The use of hired labour for these crops is mostly for ploughing,

rather than for harvesting as with cash crops. Ploughing with a pair of oxen is man's work, explaining the signs of the daysm and daysf variables in the first equation.

More income (and the implied reduced family working capacity) induces the use of hired labour substantially, with 100 shillings inducing between 1.8 and 4.6 additional hours, conditional on labour being hired at all, and depending on whether it was male or female income.

Compared to similar estimates for tea and coffee (reported in BURGER, 1990), this income effect on the hired labour demand is quite high.

The use of fertilizer and purchased seed are strongly encouraged, not so much by off-farm income, but by the presence of tree crops like tea and coffee. Growing these crops provide the household with cash income, which enable the purchase of inputs. Its effect is, however, stronger than that of yx. As will be shown below, coffee and tea growers have a strong tendency to grow hybrid maize instead of traditional varieties. The reason is probably that growers of these crops have access to cooperatives that provide the required inputs.

Education level also plays a significant role, inducing the use of fertilizers for food production much more than e.g. its use for coffee.

We now investigate the effects on the input of family labour and the impact on food production.

5 The input of family labour

Production of food crops and the input of family labour are incorporated into one simultaneous system. In view of the important role that women have in the production of food in Kenya, their labour hours were treated separately from those of the men. Male labour input, however, is often zero. For this reason the simultaneous system distinguishes overall family labour input and female labour input, so that male labour may result as difference of the two. The following system is estimated, using a 3SLS estimation routine.

lq = 4.4* + 0.41*lar + 0.14*lwff + 0.30*lwf + 0.01 lwh + 0.03*lf
- 0.47*dh - 0.04 dc + 0.04 led - 0.13 sexh

lwf = 5.10 + 0.52*lar - 0.013 lyxf - 0.024*lyxm - 0.010 lrem
+ 0.38*dh + 0.67*dc - 0.34*lac + 0.014 ldf + 0.056*ldm

lwff = 1.4* + 0.64*lar - 0.053 lyxf - 0.041*lyxm + 0.002 lrem
+ 0.42*dh + 1.50*dc - 0.21*lac + 0.360*ldf - 0.034 ldm

where lq is the log of the total value of the production of food crops in shillings, lar the log of food area, lwff denotes the log of female labour hours, lwf and lwh are the log of total family and hired labour hours, respectively, dh is a dummy, equal to one if land preparation is done by hoeing, and dc is a 1 if the household has cattle; led is an indicator for head's education; sexh represents the sex of the household head and takes the value of 1, when male and 2, when female. lyxf and lyxm are logs of female and male predetermined off-farm income, respectively, and lrem is that of remittances; lac is the log of the area under coffee or tea. ldf and ldm represent the log of female and male days available on the farm.

The resulting estimate of female labour production elasticity is now 0.14+0.3*shf, with shf the female share in the total family labour input. The higher the share, the

larger the elasticity. This difference could be confirmed on farms with both sexes working, on which elasticities of 0.20 for women and 0.05 for men resulted. The production elasticity of men can be derived as 0.3*shm, with shm being the male share. Hired labour, itself being small, has an elasticity of 0.01, and fertilizer elasticity is 0.03. Scale elasticity is 0.9, showing decreasing returns to scale, though not significantly so.

Decreasing off-farm income would induce less hiring of labour, less use of fertilizer and seed, as implied by the first set of Tobit equations; it would also lead to more input of family labour, as indicated by the simultaneous system. The two effects work in opposite direction: the reduction in purchased inputs and hired labour reduces production, the increased use of labour raises production.

A shift to no off-farm income would reduce the number of farms using hired labour from an estimated 101 to 84, and those using fertilizer from 98 to 87. These reductions are compensated by the increased use of labour: on the average farm, male family labour increases by 29 days, and female labour by 38 days. The resulting overall effect on production is to increase by 2.5 %.

Hence, food production is rather robust vis-à-vis a change in off-farm income. Any changes in off-farm earnings have hardly repercussions on the amount of food that is produced. Put in other words, there is no compensation for a drop in off-farm earnings by earning more on food production.

Remittances take about 25 % of the average predetermined off-farm income, but if they would stop, effects would be stronger than simulated above. The simultaneous model shows that male labour supply on the farm is rather sensitive to remittances: the less money is sent, the more male labour is used.

A stop in remittances leads to an increase by 30 days of overall family labour input into food production, resulting in an increase of food by 0.6 %. The average farm would lose 1058 shilling from remittances, and gain 28 sh because of reduced hired labour use, 1 sh due to reduced fertilizer purchases and another 10 sh by higher production.

When, in addition, those that remitted the money would come back to the farm (0.43 male plus 0.10 female), more hired labour would be used (but by less farms), indicating that the additional males come back to farms that hardly used hired labour. Male farm input into food production would increase by 45 days on average, and female time would go down by 2 days. All together the additional effect of a return of the workers would be an extra production of 18 sh on the average farm.

These calculation implicitly account for changes in the cropping pattern within the food aggregate. More detail is provided in the next section, which considers crop choice. In addition, the model there also considers the choice of a cash crop.

6 The impact on crop choice

A change in one of the resources, land, labour or cash should induce a shift of the crops into the direction in which best use is made of the scarce resource. Those with least cash available should grow relatively more traditional maize and sorghum, which use little cash input, whereas those with little land and labour but sufficient cash should aim for sugar cane, pyrethrum or one of the other cash crops.

Decisions on growing each of the crops are not independent. Some familiar mixtures are hybrid or local maize with beans, or sorghum, beans and local maize, whereas a combination of traditional with hybrid maize, or coffee and tea on the same farm is

rare. With so many crops, and so little information on soil and other determinants of suitability for certain crops, it is difficult to state which combination of crops is more attractive. The procedure followed here is to first describe the cropping pattern, including the interaction among the various types of crop, and then proceed to relating the parameters of this pattern to explanatory variables. The method used is a log-linear model, which allows interaction of discrete choices at any level, in addition to main effects, which is the name for crop specific effects.

The starting version of the model, as yet excluding explanatory variables, is that the probability of growing a certain combination has a log which is assumed to be a linear function of crop dummies and all interaction terms.

In the application here, four activities were distinguished:

- growing traditional maize (pure or mixed);
- growing hybrid maize (pure or mixed);
- growing other non-cash crops;
- growing non-tree cash crops.

As before, the area under tea or coffee was assumed given.

First the internal structure of these four crop choices was investigated by estimating a fully saturated model, including all first, second and higher order interaction terms, and then deleting those terms that were not significant. What remained were the four main effects, plus the traditional/hybrid maize interaction term (with a strongly negative sign) plus the second-order interactions between either traditional or hybrid maize and other food crops and cash crops.

Thus, the probability of finding a combination (d_1, d_2, d_3, d_4), where $d_i = 1$ if the i-th activity is undertaken and $d_i = -1$ if not, can be written as (MADDALA, 1983, p. 103)

$$\log P(d_1, d_2, d_3, d_4) = u_0 + u_1 d_1 + u_2 d_2 + u_3 d_1 d_2 + u_4 d_3 + u_5 d_4 + u_6 d_1 d_3 d_4 + u_7 d_2 d_3 d_4$$

where u_0 is such that all probabilities sum to unity.

In the next step, the u_i-terms were made dependent on four explanatory variables, viz. total area, area under tea or coffee, time and exogenous income. To reduce the computational burden the variables were expressed in dummies taking the value of one for a) cropped area larger than 3 ha; b) area tea plus coffee positive; c) time available for farm work more than the equivalent of 2 years; and d) farms with positive off-farm income from remittances, wage employment or business. The dummies were equal to minus one otherwise. The resulting estimates are given in the following table.

Table 1: Estimates of a log-linear model of crop choice

coef	const	time	tot area	income	tree area
u_1	-0.70*	-0.133	+0.320*	+0.063	-0.085
u_2	-0.28*	-0.056	+0.246*	+0.127*	+0.502*
u_3	-1.10*	-0.172*	-0.011	-0.180*	-0.007
u_4	+0.82*	+0.269*	-0.074	+0.193*	+0.230*
u_5	-1.16*	-0.055	+0.467*	-0.122*	-0.163*
u_6	-0.56*	-0.231*	+0.132*	-0.043	-0.057
u_7	-0.48*	-0.092	+0.077	-0.034	-0.154*

* denotes significance at 10 %.

The negative signs of the income dummy for the three u's associated with cash crops (suffixed by 5, 6, and 7) indicate that less of these crops will be grown when there is more off-farm income; similarly, income from tree crops discourages the growing of other cash crops.

Only expansion of the area would stimulate the growing of these cash crops.

Focussing on the impact of income, for each combination of much/little time or land and yes/no tree crops, the probabilities are calculated for the crop combination, depending on whether or not the farm has off-farm income. The averages and differences were calculated between each two groups that only differ as to the income dummy. The results for four of the eight cases are given in the following table.

This table shows for example that on farms with much time, much land and tree crops, local maize has an average probability of 17 %. The effect of a change in off-farm income (from no to yes) would be a change in the probability by -2 (percentage points) from 18 to 16 %. Cash crops would also be discouraged, but hybrid maize and other food crops would be more likely. In all cases, more off-farm income leads to more hybrid maize and more other food; in all cases, the growing of cash crops is strongly discouraged. Local maize is grown more, when off-farm income is earned, unless the farm grows a tree crop, in which case local maize is grown less often.

As regards the other asset variables, much land favours in particular the growing of annual cash crops, much time the growing of other food crops. The presence of tree crops has strong positive effects on hybrid maize, as opposite to local maize. Tree crops discourage the growing of annual cash crops, which effect is similar to that of off-farm income.

Table 2: Average marginal probability and income-induced change in four typical cases

assets-code* time	area	trees		traditional maize	hybrid maize	other food	cash crops
y	y	y	probab	17	85	91	16
			change	-2	5	6	-7
y	y	n	probab	56	35	81	25
			change	4	7	12	-10
y	n	y	probab	14	83	89	4
			change	-1	9	9	-3
n	y	y	probab	20	84	82	15
			change	-4	7	12	-7

* (y = much/yes, n = little/no)

The relative effects of a change in income (from no to yes) are fairly strong. The average probabilities of the crops change by +10 % for local maize, +17 % for hybrid maize, +18 % for other food crops, and -42 % for the average probability that an annual cash crop is grown.

A decrease of income, or a decrease in time is associated with an increase in the growing of cash crops. As to the effect of time, this can be ascribed to the reduced labour requirements per shilling output. The decrease along with more off-farm income is, however, of a different nature. Here, it is not the endowment reasoning that applies, because most cash crops have relatively high purchased input requirements. Rather, it seems that there is substitutability on the output side, with off-farm income substituting for cash income from these crops or vice versa. This reflects a decreasing marginal utility of cash income.

Most cash crops yield returns that are quite favourable compared with food crops, at least at the prevailing market prices. The average hourly returns vary from around 1.5 sh per hour for sunflowers to 3.7 sh per hour for pyrethrum and 9.6 sh for sugar cane, of which only the latter is higher than the average hourly earnings in wage employment. Growing sugar cane is, however, limited to certain areas where processing capacity is available. Using the estimated average probabilities of growing the four types of crop as weights, and taking as average hourly gross margin of traditional maize 1.8 sh, of hybrid maize 1.4 sh, of other food crops 2.5 sh and of cash crops 4.5 sh per hour, an average margin per family hour can be calculated, which comes out as 2.1 sh per hour. The effect of more income on the cropping pattern would work out in such a way that this average decreases to 2.0 sh per hour. Reason is the decrease in cash crops, which is not compensated by the increase in the other crops. Hence the change in cropping pattern by itself, holding the inputs per shilling of each crop constant, does not increase the shadow price of labour on the farm.

7 Conclusions

When members of rural households have the opportunity to start a succesful business or take up remunerative wage employment either as a migrant worker or as off-farm occupation, the resulting changes in the farm household are on average (non-weighted).

42 % reduction of the marginal probability of annual cash crops, 17 % increase in that of hybrid maize and 10 % in that of traditional maize, and +18 % for other food crops. If tree crops are grown, these percentages are -5 %, +8 %, -2 % and +10 %, respectively. This would result in a reduction of the farm earnings from 2.1 sh to 2 sh per hour. For the food aggregate this would result in an increase by, on average, 9 %, where the average is taken over all combinations of little/much land, little/much time, yes/no tree crops. For the modal farms without tree crops, with little land and much time, the probability of growing food at all would rise from 76 % to 94 %.

Conditional on food being grown at all, the effects are:

more use of cash inputs:

- a 50 % increase in the total use of hired labour, and an increase by 21 % in frequency of use;
- a 9 % increase in fertilizer use, and a 13 % increase in the frequency of its use.
- 0.3 % increase in the use and frequency of use of seed.

less input of family labour:

- reduction of female labour hours by 7 % and of male labour hours by 5 %.

less production:

- decrease in production by 2.5 %.

At the aggregate level this decrease in production is more than compensated by the increased frequency at which food is produced.

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