Women

The Efficiency of Women as Farm Managers: Kenya*

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Using farm-level data from an area of Western Kenya, this paper investigates possible differences between male and female farm managers in the possession of, and means of acquiring, technical information relevant to the production of maize (Zea mays, or corn), the staple commodity of the area. By "technical information," we mean knowledge relating to the manner in which inputs are combined. Producers are said to differ in technical efficiency when they experience systematic differences in the output produced from a given combination of inputs.[1] Allocative decision-making, which has to do with the quantities of inputs used as distinct from the techniques of input use (cf. Shapiro, p. 2), is excluded from our analysis in the absence of farm-specific price data.

The section that follows describes the geographic area, giving an explanation of the high proportion of female farm managers (relative to the ratios found in most farming communities, in Africa and elsewhere). In section two, the data are described, and the model set out in general terms. Section three presents the empirical analysis, and section four, some conclusions.

Women as Farm Managers in Vihiga Division

The sample[2] consists of 152 maize farmers in Vihiga, an administrative division of roughly 200 square miles and 300,000 people in Western Kenya. Reflecting the high average population density, the typical holding consists of 7 resident members and just 2.5 acres.[3] The area's response to population pressure is a pattern of circular labor migration, especially on the part of male household heads. In a random survey conducted in 1971, one-third of farm heads was found to be currently away from the family farm, engaged in work or work-search. The typical farm head had spent nearly a quarter of his total years away. The mean cumulative migration period was 11 years.

In the head's absence, farm management is relegated to another farm family member. In most cases, this is the wife of the farm head, and Vihiga is a notable farm community for its extent of female management. In 1971, 38 per cent of the division's farms were managed by women. Whereas women perform a substantial portion of the physical work on farms throughout Africa, as farm managers the women of Vihiga have assumed considerably more decision-making responsibility than is generally the case elsewhere.

The Model

The variable list appears in Table 1. Wherever meaningful, variables are expressed as area rates, a procedure that reduces colinearity among inputs and transforms X_1 (area planted) into a measure of production scale. An estimate of yield (shelled and dried maize per acre) was obtained on each farm by sampling the stand and hand harvesting the selected parts of the crop. The mean was 17.6 "bags," which translates approximately as 63 bushels, per acre. All data were recorded during the principal planting season of 1971.

As a first approximation, the production model consists of the single multiplicative equation

$$\text{(1)} \qquad YIELD = aX_1^{b_1} \cdots X_4^{b_4} e^{(b_5X_5 + \cdots + b_{11}X_{11} + u)} ,$$

in which e is the base of natural logarithms and u is a random disturbance variable. The tractable inputs, i.e., those affected by farmer decisions ($X_1, \ldots, X_8$), and three indicators of natural phenomena ($X_9, \ldots, X_{11}$) are defined in the table.

This model is incorrectly specified if knowledge can be said to enter into the production process. If farm managers hold different levels of technical information, and the correlations are nonzero between information and variables X_1 through X_{11}, then the estimates of b_1 through b_{11} will be biased. The variables specified as the direct and indirect sources of technical information are formal schooling (X_{13} and X_{14}), experience (X_{15} and X_{16}), and extension contact (X_{17} and X_{18}).[4] In general these are factors found elsewhere to affect the allocative ability of farmers.[5]

The final information proxy, X_{12}, has been mentioned as the focus of this paper. The right-hand columns in Table 1 allow us to compare means (and standard deviations) for the male and female subsamples. On average, output per acre was smaller for women (17.1) than for men (17.8), but the difference is not significant even at the .10 probability level.[6] The absence of a significant difference is provocative when we observe that, in general, the women used smaller bundles of physical inputs, especially store-purchased inputs, than did their male counterparts. They used noticeably less chemical fertilizer (X_4) on average and are less likely to have planted one of the hybrid seed varieties (X_5) or to have used insecticide (X_6), although the mean labor input (X_3) was marginally higher on female-managed farms than on male-managed farms.

The proof of the pudding, should anyone doubt that these women were more technically efficient maize farmers than the men, is the positive coefficient on X_{12} in a regression equation (not shown) that controls for physical inputs and natural factors - i.e., in the estimation of model (1), with the term $b_{12}X_{12}$ added to the expression in parentheses. The b_{12} estimate is 0.066, suggesting that a woman obtains 6.6 per cent more output at the mean levels of input use than does a man, and this coefficient is significant at the .10 level.[7]

The empirical section is an analysis of the male-female efficiency difference. Two questions are explored: (1) Do the men and women of Vihiga benefit differentially from schooling, experience, and extension contact? and (2) Do we observe input-specific productivity differences in the production relationships, for the male and female subsamples, when we have accounted for information sources that shift the relationship neutrally?

Empirical Analysis

The analysis begins with three estimations of a production model in which information sources ($X_{13}, \ldots, X_{18}$) are assumed to affect inputs ($X_1, \ldots, X_{11}$) neutrally. The estimated equations are given in Table 2. Equation (a) is based on observations of male management only; equations (b) and (c), on female.[8]

Comparisons of the regression coefficients in (a) with those in (b) or (c) suggest several intriguing interactions between variables in the equations and manager's sex, the criterion used in partitioning the sample. Some of these interactions are "tested" in the following equation[9] based on the full sample of 152 farms:

$$
\begin{array}{llll}
(2) & \text{YIELD}' = .461 & - .054(\text{SCALE}') & + .090(\text{WOMAN})(\text{SCALE}') \\
 & & *(-1.25) & *(1.29) \\
 & + .733(\text{PLNTP}') & - .280(\text{WOMAN})(\text{PLNTP}') & + .056(\text{LABOR}') \\
 & (7.10){+}{+}{+} & *(-1.85){+} & (.998) \\
 & + .108(\text{WOMAN})(\text{LABOR}') & + .039(\text{CFERT}') & + .100(\text{HYBRD}) \\
 & *(2.15){+} & (4.17){+}{+}{+} & (1.38){+} \\
 & + .098(\text{INSEC}) & + .091(\text{INTER}) & + .087(\text{SOIL}) \\
 & (1.58){+} & (1.90){+}{+} & (2.17){+}{+} \\
 & - .121(\text{HAIL}) & - .187(\text{DAMG1}) & - .299(\text{DAMG2}) \\
 & (-2.16){+}{+} & (-4.25){+}{+}{+} & (-4.70){+}{+}{+} \\
 & - .112(\text{SCHL1}) & + .167(\text{WOMAN})(\text{SCHL1}) & + .215(\text{SCHL2}) \\
 & (-1.95)! & *(1.98){+} & (2.02){+}{+} \\
 & + .030(\text{XTNSN}') & - .038(\text{SCHL2})(\text{XTNSN}') & - .028(\text{WOMAN})(\text{XTNSN}') \\
 & (2.82){+}{+}{+} & (-1.92)! & *(-1.50) \\
 & - .061(\text{LOAN}) \ , & R^2 = .705 & \\
 & (-.784) & &
\end{array}
$$

<u>Educational attainment</u>. Whereas a little schooling (one to three years) is associated with higher yields for the women in our sample, this finding does not apply to the male subsample. If anything, in the men's case the relationship is an inverse one between some schooling and technical efficiency.

On the other hand, those who have attained four or more years in the formal system, men and women alike, do obtain more output per unit of inputs, on average, than do farmers who have not been to school.[10]

Experience. Equations (b) and (c) in Table 2 suggest that migration experience (years away from home) is a detriment to a woman's technical skills as farmer, though the coefficients on MIGR' are not significant in two-tailed tests.[11] By way of contrast, there is no indication in equation (a) that prior absence affects a male manager's skills in one direction or the other. A reasonable interpretation of this tentative result is that men, when they "go to town," typically leave the family at home and, through visits and correspondence, manage to keep informed about the farm, whereas women who migrate are, in most cases, accompanied by husband and children. With no immediate family left on the farm, they do not learn of new techniques in farming. The equations in Table 2 indicate that manager's age correlates positively with technical efficiency, as predicated,[12] but only for women. The correlation does not exist for men. These interactions, while interesting, are weak and do not hold up in any equation based on the full sample. Thus, the experience variables are left out of equation (2).

Extension service contact. Equation (2) indicates that exposure to the Ministry of Agriculture (MOA) is associated with greater technical efficiency, provided the farmer is male and not too well educated! The elasticity with respect to XTNSN is .03 for males who have three years or less of schooling, but the effect vanishes for men with four or more years' attainment, nor is it present in the case of women.[13] All else equal, the possession of a government loan for the purchase of maize inputs (seed, fertilizer, and insecticide) is associated, in Table 2, with smaller yields, actually, for female managers - a paradox since loan recipients were to be given close supervision.

Differential input elasticities. In Table 2, we see some apparent differences, between the male and female subsamples, in the size of the effects of various inputs on the output measure. Two of the differences are significant, and one nearly so, and these appear in equation (2). The women in our sample seem to have made better use of labor in the production of maize than did their male counterparts, and they benefited less from the density of the maize stand (PLNTP). The returns to production scale appear positive for women and negative for men, although in neither case is the effect significantly different from zero. Ex post "explanations" of these differences would be highly speculative and are not attempted in this paper.

Conclusions

This paper has looked at sex-linked differences in production knowledge on the part of small-scale maize farmers in an area of Kenya. This topic has not been investigated elsewhere, to the author's knowledge. If such differences do exist, they are likely to be quite local and transitory phenomena, and the hypotheses tested here relating to male-female differences in technical efficiency have been nondirectional ones. To conclude this paper, the author summarizes the findings and suggests some interpretations.

We have seen that the impact of schooling on output, other factors remaining the same, is greater for the women in our sample than for the men. In fact, the men who had been just a few years to school performed less well on the efficiency criterion than those who had never been to school. The author would conclude that literacy and numeracy, the skills emphasized in primary education, are applicable to the acquisition of information used in small-scale farming, as evidenced by the schooling-output relationship for women.

However, amongst Vihiga's male population, those who advance further in school are more likely to participate in the search for off-farm employment. Of those who search, as a rule only the more able individuals find and keep jobs. Thus, we argue, the men found managing farms despite educational credentials tend to be of lower than average ability. This selection mechanism, which biases the male subsample with respect to the overall ability distribution, probably does not apply to the women, who are not in most cases expected to find work off the farm. It may not apply either, at least to the same extent, to men with four or more years of school. These "very educated" men often find off-farm employment locally (e.g., as shopkeepers or primary teachers), which allows them to look after their farms at the same time (J. Moock).

Another striking finding has to do with the impact of the extension services on farming. The women seem not to benefit, though the men do, from extension contact. A reason may be the marked male orientation of the services as provided by Kenya's MOA. The staff consists almost entirely of men, the few exceptions dealing exclusively with "home economics" (nutrition and health). Moreover, much of the Ministry's agricultural instruction takes place at the chiefs' barazas (regularly held meetings), attendance at which is seen particularly as the prerogative of male elders. Although women do attend, their participation is limited. The Ministry makes scant use for instructional purposes of the churches, in which women play a much more active role.

Some farmers in the sample received maize input loans in 1971, granted through the Ministry in conjunction with Kenya's Agricultural Finance Corporation, and as credit recipients they qualified for special extension services. The loans were extended that year as part of an experimental rural development program. In planning the program, the government staff was divided, a vocal minority arguing against the inclusion of women, whose farming skills and whose obligation to repay debts (under existing laws) were considered dubious. Although this view did not prevail, and some women received credit, this skepticism may have exacted its toll, since the women with loans got smaller yields on average, other things the same, than did the women without them.

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Table 1. Variable list, and summary statistics for full sample (n=152) and for male (n=101) and female (n=51) subsamples[a]

Name	Description	Units	Sample	Male	Female
DV-YIELD	Maize output per acre	200-lb bags	17.6 (5.7)	17.8 (6.1)	17.1 (4.9)
	Physical inputs and natural factors				
1. SCALE	Area planted in maize	Acres	1.6 (1.1)	1.8 (1.2)	1.2 (0.7)
2. PLNTP	Plant population per acre	1,000 plants	9.6 (2.3)	9.8 (2.3)	9.2 (2.2)
3. LABOR	Labor input per acre	Hrs	983 (339)	974 (336)	1,002 (346)
4. CFERT	Chem. fertilizer applied per acre	Lbs	72.6 (57.8)	79.8 (59.1)	58.5 (52.9)
5. HYBRD	Planted any of hybrid varieties	0,1	0.89	0.92	0.84
6. INSEC	Used insecticide	0,1	0.31	0.39	0.16
7. INTER	Interplanted legume among maize	0,1	0.57	0.51	0.67
8. SOIL	Applied fertilizer or left field fallow previous season	0,1	0.36	0.43	0.24
9. HAIL	Hailfall damage	0,1	0.82	0.80	0.84
10. DAMG1	Moderate damage from erosion or striga weed	0,1	0.22	0.25	0.18
11. DAMG2	Severe damage from erosion or striga weed	0,1	0.09	0.10	0.08
	Information proxy variables				
12. WOMAN	Manager a woman	0,1	0.34	0	1
13. SCHL1	Schooling, 1 to 3 yrs	0,1	0.34	0.34	0.33
14. SCHL2	Schooling, 4 yrs or more	0,1	0.34	0.43	0.16
15. MIGR	Migration experience	Yrs	9.4 (10.8)	12.6 (11.2)	3.0 (5.9)
16. AGE	Age	Yrs	48.8 (12.3)	51.8 (12.6)	42.9 (9.3)
17. XTNSN	Extension contact	Index	178 (92)	191 (98)	152 (72)
18. LOAN	Loan recipient--special extension services	0,1	0.43	0.50	0.29

[a]The summary statistics reported are means and, in parentheses, standard deviations.

Table 2. Regression estimates for generating hypotheses concerning male-female differences in technical efficiency[a]

Variable[b]	(a)	(b)	(c)
Subsample	Male (n=101)	Female (n=51)	Female (n=51)
CONSTANT	.514	-.565	-.585
*1. SCALE'	-.078 (-1.46)	.097 (1.47)	.097 (1.51)
2. PLNTP'	.754 (6.49)+++	.462 (3.96)+++	.462 (4.02)+++
3. LABOR'	.070 (.939)	.153 (1.81)++	.154 (1.86)++
4. CFERT'	.034 (2.63)+++	.045 (3.01)+++	.045 (3.08)+++
5. HYBRD	.135 (1.41)+	.113 (.996)	.116 (1.07)
6. INSEC	.039 (.486)	.278 (2.55)+++	.277 (2.59)+++
7. INTER	.102 (1.68)++	.053 (.559)	.050 (.555)
8. SOIL	.097 (1.88)++	.128 (1.61)+	.128 (1.64)+
9. HAIL	-.060 (-.878)	-.310 (-2.95)+++	-.310 (-3.01)+++
10. DAMG1	-.180 (-3.25)+++	-.184 (-2.29)++	-.186 (-2.43)++
11. DAMG2	-.339 (-4.31)+++	-.094 (-.871)	-.094 (-.890)
13. SCHL1	-.119 (-1.81)!	.187 (2.08)++	.189 (2.13)++
14. SCHL2	.177 (1.37)+	.382 (.272)	.209 (2.04)++
*15. MIGR'	.0031 (.329)	-.017 (-1.64)	-.017 (-1.66)
16. AGE'	-.071 (-.702)!	.325 (1.74)++	.330 (1.85)++
17. XTNSN'	.029 (2.52)+++	-.0072(-.406)!	-.0075(-.434)!
18. LOAN	.072 (.721)	-.440 (-3.38)!	-.444 (-3.58)!
(SCHL2)(XTNSN')	-.033 (-1.45)!	-.034 (-.122)!	
R^2	.853	.889	.889

[a]Dependent variable is log of YIELD. Regression coefficients are given first, followed by t statistics in parentheses. One, two, and three plus signs indicate significance levels of 0.10, 0.05, and 0.01 respectively. An exclamation mark indicates sign of coefficient opposite from predicted sign.

[b]An asterisk indicates a two-tailed test; a prime, that the variable is entered in log form.

Footnotes

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[1]In addition to systematic differences, output may be subject to random disturbances.

[2]The data set is described more fully elsewhere (P. Moock, 1973).

[3]These are median estimates, derived from an earlier, probability sample of farms in the division (P. Moock, 1971).

[4]The appropriate algebraic specification of these variables, in the model "corrected for management bias," is by no means obvious, and the equations reported in the empirical section below are the "best performing" of many that were estimated.

[5]See the Midwestern U.S. studies by Huffman and Fane, and the general review by Schultz. The effect of educational factors on technical efficiency has been called the "worker effect" of education, as distinct from the "allocative effect" (Welch).

[6]Geometric means were even closer numerically -- 16.4 and 16.7.

[7]It falls just outside the critical region for rejection of the null hypothesis at the .05 level; the t statistic is 1.63, and the critical value, 1.66.

[8]In (c), the school-extension interaction term is omitted, since the cor-

relation between SCHL2 and the product variable is .998 for women (cf. .881 for men).

[9]See footnotes to Table 2. Note that the dummy variable, WOMAN, does not appear by itself in equation (2). When added, its coefficient, while positive, is not significant, nor is the coefficient on the female-labor product variable (the two are correlated at .997).

[10]Taking the partial derivative of (2) with respect to SCHL2, and using the mean value of XTNSN' (4.348), we get

$$\partial YIELD'/\partial SCHL2 = .177 - .033(4.348) = .034 \quad .$$

Judging from Table 2, this estimate probably understates the effect of SCHL2 for women, though not for men.

[11]The sign of b_{11} could not be predicted *a priori*, since the content of migration experience is nowhere indicated in the data set although this dimension is known to vary substantially across farm managers.

[12]Age, migration time held constant, serves as a measure of experience *on the family farm* and, at least as such, should be a *direct* indicator of production knowledge.

[13]The index, XTNSN, is based on five binary indicators of extension contact: "Since this time last year, have you ..." (a) been to consult a MOA instructor? (b) been visited by a MOA instructor? (c) attended a MOA crop demonstration? (d) attended a MOA animal demonstration? (e) attended a course at a Farm Training Center? The procedure used to weight indicators is described elsewhere (P. Moock, 1973, pp. 160-165).