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Jean M. Due and P. Anandajayasekeram

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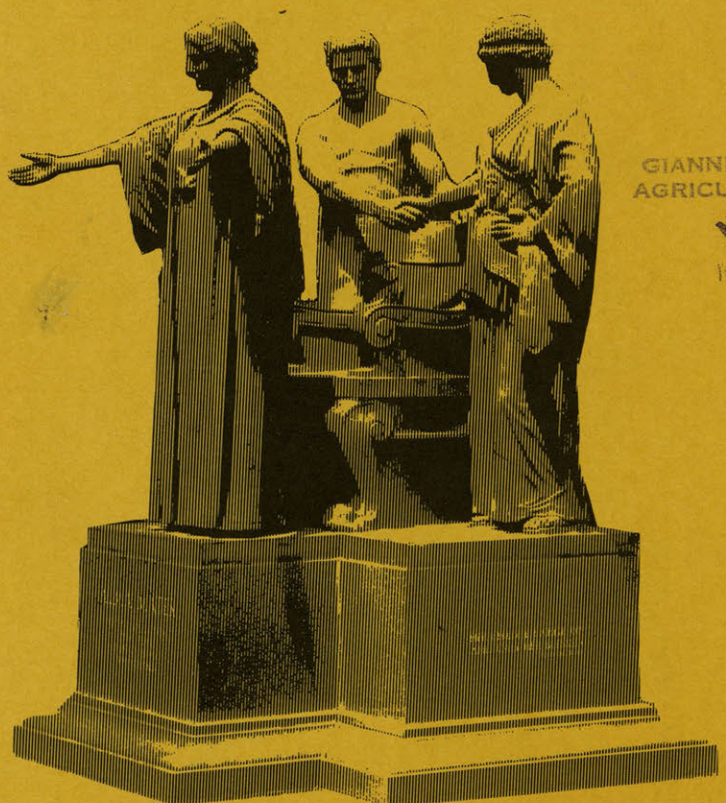

Department of Agricultural Economics
University of Illinois at Urbana-Champaign
305 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801

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Jean M. Due*

*Dr. Jean M. Due is Professor of Agricultural Economics, University of Illinois at Urbana-Champaign. Data were gathered by Prof. P. Anandajayasekeram, University of Dar es Salaam, Morogoro and by two university students A. Kashuliza and Z. Rashidi. Funds for this research were supplied by Title XII (USAID) through the University of Illinois, University of Dar es Salaam, Morogoro, and USAID through the Bean/Cowpea CRSP. Research assistants at the University of Illinois-UC who supplied valuable assistance were Tom Gillard-Byers and Marcia White. Helpful comments were made by Professors Bruce Dixon, Sam Johnson, and Emmanuel Manday; errors, of course, are the responsibility of the author.

Women and Productivity in Two Contrasting Farming Areas of Tanzania

Jean M. Due

Average labor productivity is normally calculated by dividing total value product by the number of workers, assuming that the amount of all other factors has remained constant. Marginal productivity of the last unit of laborers hired is calculated by dividing the increase in value product resulting from hiring these persons by the number hired. This paper attempts to compare the productivity of women and men in two contrasting agricultural systems in one region of Tanzania (Morogoro), areas not more than 100 miles apart. My hypothesis is that productivity of male and female labor is similar in each district but the productivity of female labor in the two areas[1] is strikingly different even though females in both areas are involved in farming for most of their total income.

Productivity in this paper is being measured in the traditional economic manner; not included in total productivity of females is one-half of the women's double day allocated to household and family chores--meal preparation, child care, fetching water and fuel, and so forth. Comparisons are being made only between production of agricultural commodities for consumption or sale, the growing of which is undertaken jointly by males and females.

Background

The two areas are Kilosa and Mgeta, both within 50 miles of the city of Morogoro, the regional center and site of the Faculty of Agriculture, Forestry and Veterinary Science of the University of Dar es Salaam. In Kilosa, a drier district at altitudes between 500 and 1,000 meters and with rainfall averaging between 800 and 1,000 millimeters per annum (1), one cropping season per year is common; sometimes a second crop is planted after the first crop is harvested (beans after maize or sorghum, for example) but this occurred for less than one-third of the farm families sampled. In Mgeta,

[1] This was predicted by colleagues in Tanzania; it was believed value of total production per family was three times higher in Mgeta than in Kilosa.

farms are at elevations between 1,200 and 1,800 meters above sea level with annual rainfall averaging between 760 and 1,600 mm. (1). The higher elevation and rainfall allow multiple cropping. How does labor productivity differ in these two contrasting farming systems not more than 100 miles apart?

Tanzania is a predominantly agricultural country with an annual per capita GNP of $260 (in 1979) with 83 percent of the labor force in agriculture (2). Agriculture, including livestock and fishing, contributed 54 percent of GDP in 1979, one-half of which was accounted for by agricultural export earnings from coffee, tea, cotton, sisal, cashew nuts, and tobacco (2, pp. 134-70).

In order to obtain data on the present farming systems in those two areas within Morogoro region a sample of 60 families was drawn from villages in major bean growing areas of the region.[2] Kilosa and Mgeta had the infrastructure to allow visits over 12 months of the year (with 4 wheel-drive-vehicles). Each village has lists of all families farming in the village[3], so a random sample of every jth family was drawn from the lists for a total of 59 (58 in Kilosa) usable questionnaires in each area. Questionnaires were administered by university students who also utilized the data for their BSc theses.

Farming Systems

In Kilosa, farm families' major crops were maize (the major food staple), sorghum, rice, cotton, beans, and other vegetables. Average acreages of each major crop are shown in Table 1 along with socioeconomic data on families sampled. In Mgeta, maize also was grown by each family but vegetables were much more important in the farming system - beans, cabbage, cauliflower, lettuce and pigeon peas (see Table 1).

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[2] The data were gathered to implement the Bean/Cowpea CRSP research. This interdisciplinary research is being undertaken by crop scientists and agricultural economists at USDA, Washington State, and the Universities of Dar es Salaam, Morogoro and Illinois-UC. The research will attempt to develop new higher yielding varieties of beans for Tanzania which are drought and disease resistant and to assess their impact on small farm families. Headquarters of the CRSP are at Michigan State University.

[3] Families were not in any particular order on the list; each village had about 400 families.

Table 1. Socioeconomic Data of Farm Families in Two Districts of Tanzania, 1980

	Kilosa	Mgeta
Number of families sampled	58	59
Means of:		
Age of head (years)	40.1	45.4
Age of spouse (years)	33.3	35.4
Number of wives	1.2	1.0
Family size	4.8	6.0
Male-persons farming[1]	1.6	1.6
Female-persons farming[1]	1.6	1.8
Total persons farming[1]	3.2	3.4
Years of formal schooling (head)	3.3	3.0
Years of farming (head)	19.2	24.8
No. of fields operated	3.8	5.5
No. of crops grown	6.2	6.4
Acres of maize	2.5	2.8
Acres of sorghum	1.3	0
Acres of beans	.5	1.4
Acres of rice	1.3	0
Acres of cotton & sunflower	1.4	0
Acres of cabbage	0	.8
Acres of cauliflower	0	.6
Acres of cassava	.1	.3
Acres of pigeon peas	.1	.7
Acres of onions	0	.1
Acres other	1.2	1.7
Total Acreage	8.4	8.4

[1] Person equivalents in full time farming were calculated as follows: Adult males and females 18 years and over 1; males and females 12-17, .5; and males and females 8-11 years, .3. If persons were farming less than 12 months, a percentage was calculated.

Data presented in Table 1 show that the families in Mgeta are slightly older, larger and have more persons in full time farming (3.4 compared to 3.2) than families in Kilosa district. Average years of formal education of the head of the household were very similar; Mgeta families had more years of farming experience and the ratio of females to males was slightly higher than in Kilosa.

Average acreages of crops grown per family were also identical -- 8.4 in each district. (This average was calculated by totalling all acreages used; if one shamba (field) is used 3 times during the year and was 1 acre in size, that shamba accounted for 3 acres.) The Mgeta families had smaller farms used more frequently during the year; in Kilosa only 18 acres were double cropped; these acreages were all in beans and averaged .3 of the 8.4 cropped acres per farm. In Mgeta such data were not available.

In each of the areas maize was the most important crop and was grown by every family. Beans also were grown by every family but one in Mgeta district but only by 43 percent of the families in Kilosa in 1980.[4] Major crops with the number of families growing them are shown below:

	Kilosa	Mgeta
Maize	58	59
Sorghum	36	1
Rice	32	0
Cotton	27	0
Beans	25	58
Sunflower	31	0
Cassava	11	21
Pigeon peas	13	33
Cauliflower	0	42
Cabbage	0	49
Lettuce	0	22

Husbands and wives jointly made decisions on which crops were planted in 83 percent of the families in Mgeta and 85 percent in Kilosa.

Value of Total Production

When calculating value of total production (VTP), a decision had to be made as to whether to use government guaranteed prices or open market prices for those products that were sold. The government had guaranteed prices for cotton, sunflower, and the major staple grains and pulses - maize, sorghum

[4] Although we were told that Kilosa district was a major bean growing area by Ministry of Agriculture (KILIMO) officials, only 43 percent of the families grew beans during 1980.

and dried beans. Furthermore, the government tries to enforce marketing of those products through the official marketing agencies. There is no open market (to any extent) for cotton; however, for food grains and pulses the open market price was several times higher than the government price depending on the time of year. The government price remained constant over the country and over the year. A comparison of average prices (in Tanzanian shillings per kilogram) for major crops grown in 1980 is shown below:

Major crop	Government price	Open market price[5]
Maize	1.00	2.50
Sorghum	1.00	3.00
Rice	1.20	2.00
Cotton	3.25	0
Beans (dried)	3.50	5.00

There were no guaranteed government prices for the vegetables — cabbage, cauliflower, lettuce, and green beans. Thus the Mgeta farmers had much less access to government guaranteed prices for the crops which they produced than the Kilosa farmers.

Since most of the farm families sold their crops at open market prices, the prices which they reported were used in valuing both production and consumption (Table 2). Consumption of a given crop was valued at the same price as any of the crop sold.

Table 2 compares average value of total production per farm in the two areas together with the percentage of production consumed. It will be noted that average value of total production per family is remarkably similar in the two districts as is the percentage of the total crop consumed. In Mgeta, maize was grown for home consumption; 99 percent of the maize was consumed; in Kilosa only 55 percent of the maize grown was consumed by the farm families. Mgeta families grew twice as many beans as Kilosa families selling over one-half of them as either dried or green beans. Mgeta families also grew fewer cereals but more vegetables including pigeon peas. In both districts it was impossible to obtain accurate data on minor crops grown for home consumption; it is certain that Kilosa families also grew vegetables but the enumerators did not record them except in the category

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[5] Obtained in markets in the region by Dr. Anandajayasekeram.

Table 2. Average Values per Family of Farm Production (in Tanzanian Shillings[1]), Kilosa and Mgeta Areas of Tanzania, 1980

	Kilosa		Mgeta	
	Value	% Consumed	Value	% Consumed
Major crops produced	Tsh	%	Tsh	%
Maize	2,306	55	1,942	99
Sorghum	1,082	53	24	100
Rice	1,134	43	0	0
Cotton	475	0	0	0
Beans	490	67	997	46
Pigeon peas	106	96	547	20
Sunflower	251	21	0	0
Cabbage	0	0	881	18
Cauliflower	0	0	1,050	6
Lettuce	0	0	177	17
Cassava[2]	0	0	73	100
Onions	0	0	53	40
Other	605	65	764	30
Total	6,449	50	6,508	47

[1] Tanzanian shilling was equivalent to U.S. $0.125 at the time.

[2] Included in other.

"other". In Mgeta the major crops under other were potatoes, bananas, and plums. Many families sold plums as well as using them for consumption.

As would be expected with perishable vegetables, there was much more waste of crops intended for sale in Mgeta; this was estimated to be 7 percent of total production. These were vegetables prepared for market and not sold or for which no transport was available to take them to market. In Kilosa reported crop wastage was less than 1 percent of total production.

Thus my second hypothesis, that women's productivity in the two areas, (based on the assumption that value of total production per family would be much higher in Mgeta than Kilosa due to multiple cropping in Mgeta) is invalid since average value of total production per family was almost identical in the two areas.

Value of total cash income

The average total cash income per family from farming was 3,249 Tsh ($406) in Kilosa and 2,966 ($371) in Mgeta. How did sources of cash income compare? They are shown in Table 3. Livestock sales (including poultry and eggs) were slightly higher in Mgeta than in Kilosa; ownership of sheep and goats also was more common in Mgeta than in Kilosa. Opportunities for off-farm employment were more numerous in Kilosa than in Mgeta; in Kilosa some 11 male family members were teaching, working on construction, butchering, wood cutting or doing road work, four female members obtained off-farm income from nursing, teaching, trading or selling pombe (beer). In Mgeta 7 males found off-farm employment in construction, marketing, tailoring, and woodworking. Three females had employment in marketing and working in hotels.

Not only were families asked to recall amounts of products grown and sold, they also were asked to estimate their total cash income by ranges in order to estimate their total income for the year. These data are presented in Table 4. It will be noted that Mgeta families estimated their total family income at about 5,000 Tsh while Kilosa families' estimates were closer to 2,000. The estimated ranges are considerably below the recorded incomes in Kilosa and above them in Mgeta.

Table 3. Average Total Cash Income of Sampled Families (In Shillings) in Kilosa and Mgeta, Tanzania, 1980

Cash income sources per family:	Kilosa	Mgeta
	Shillings	
Crops	3,249	2,966
Livestock sales	101	294
Off-farm employment - male	244	156
female	82	110
Gifts & other - male	42	17
female	0	0
Sub-total (off-farm)	368	283
Total family cash income	3,718	3,543

Table 4. A Comparison of Estimated Range of Total Income by Sampled Families in Kilosa and Mgeta, Tanzania, 1980 (in Tsh)

	Kilosa		Mgeta	
	Number of		Number of	
Income range (Tsh)	Families	%	Families	%
Less than 1,000	1	2	1	2
1,000-1,499	8	14	3	5
1,500-1,999	16	27	4	7
2,000-2,499	14	24	6	10
2,500-2,999	7	12	3	5
3,000-4,999	3	5	17	29
5,000-7,499	8	14	16	27
7,500 & over	1	2	9	15
Total	58	100	59	100

Farm capital owned

Our data confirm the small investments in capital assets (tools and farm equipment) on traditional Tanzanian farms; average value of capital owned in 1980 was 185 Tsh per family in Kilosa; capital acquired was primarily hoes, pangas (large knives), axes and bush knives; average depreciation for the year was 56 Tsh[6]. Capital equipment was similar in Mgeta with an average value of 180 Tsh per family; average depreciation costs on this equipment was 78 Tsh per annum per farm.

Operating costs

Very little hired labor was utilized in either district - only Magole and Dumila in Kilosa reported both tractor hire (8 families) and hired labor (1); in Mgeta only Tchenzema had each of these costs. Tchenzema also had costs for seed, fertilizer, chemicals and transportation. None of the Kilosa villages used purchased seed or fertilizer. A comparison of operating costs per farm (including depreciation) is shown in Table 5.

Use of family earnings

How were net family earnings allocated between consumption and savings? It is seen from Table 6 that when average family incomes from crop and livestock sales (less farm operating costs) are added to off-farm income and gifts, the annual cash incomes per family in the two areas were almost identical [3,442 Tsh ($430) in Kilosa and 3,369 in Mgeta]. Family living expenditures averaged 2,485 Tsh in Kilosa and 3,205 in Mgeta, leaving 957 Tsh ($120) in Kilosa and 164 ($20) in Mgeta for saving or other uses.

Labor utilization in production

Data gathered in Kilosa allowed a comparison of average total amounts of labor needed by crop for land preparation, planting, weeding, harvesting and marketing activities. These totals are shown in Table 7 as are the percentages of total labor which were contributed by females for each crop. In order to obtain these labor utilization data assumptions had to be made as to the adult equivalencies of persons of different ages and sexes working

[6]Each family was asked the price of the capital items and its expected life. Depreciation was calculated on a straight line basis from data given on cost and life expectancy.

Table 5. A Comparison of Average Farm Operating Costs (in Tsh) per Family, Kilosa and Mgeta, Tanzania, 1980

	Kilosa	Mgeta*
Hired labor	5	20
Seed	0	36
Fertilizer	0	18
Manure	0	6
Chemicals	0	6
Rental of Machinery	215	6
Depreciation	56	78
Transportation	0	4
Total	276	174

* Estimated to date.

Table 6. Use of Average Family Cash Earnings (in Tsh) In Kilosa and Mgeta, Tanzania, 1980

	Kilosa	Mgeta
	Shillings	
Crop sales	3,249	2,966
Livestock sales	101	294
Less farm operating costs	276	174
Net farm cash income	3,074	3,086
Off-farm income & gifts	368	283
Total net cash income	3,442	3,369
Family living expenses	2,485	3,205
Balance	957	164

at differing lengths of time in production. The equivalencies used at the Department of Rural Economy, University of Dar es Salaam (called Morogoro equivalencies) are adaptations of Collinson (3) and Ruthenberg (4) and are as follows:

Age	10-14	15-19	20-50	Over 50
Males	.25	.67	1.00	.67
Females	.25	.60	.90	.60

Conversations with Tanzanians and actual observations of agricultural production by the author noted the need for equality of work of males and females of the same age; it is true that males may accomplish more per day in heavy work (e.g., hand ploughing); however, in some activities (e.g., harvesting) data supports female superior accomplishments; thus over-all equivalencies. Since the Tanzanian data arrived at Illinois already converted to Morogoro equivalencies, the author adjusted the female labor upward (by dividing by .9) in those cases where equality was not established, to accomplish equality of effort by each sex, on average. In this decision I am in agreement with Delgado who wrote:

> "The conclusion is that there is very little or no basis for estimating that a female worker is worth less than a male worker in the same age group." (5)

The distribution of labor by major crop per acre was remarkably similar in the three villages in Kilosa whether the Morogoro or Illinois equivalencies were used. Cotton utilized more than twice as much labor as maize; sorghum, beans and rice used approximately the same amount of labor per acre (approximately 31 days a year). Sunflower uses approximately one-half that of beans and rice. Thus cotton was the most labor intensive and sunflower the least (Table 7). The Due equivalencies show higher total days per acre; some of this increase is simply due to rounding of decimals in recalculating female equivalencies.

However, it is the distribution of labor between the sexes for each major crop which is the most interesting. Men put in more labor in all major crops except beans and rice in Kilosa district; in the production of rice and beans women invest 59 and 67 percent of the labor, respectively. This type of information is important if changes in varieties or sequencing of crops is recommended in the area.

Table 7. Average Labor Utilization on Major Crops per Acre, Kilosa, Tanzania, 1980, Based on Morogoro and Due Adult Equivalencies

Major Crop	Total Labor Days per Acre		Percentage Female per Acre	
	Morogoro	Due	Morogoro	Due
Maize	21	22	46	48
Sorghum	31	32	38	40
Rice	31	33	64	67
Cotton	49	51	37	40
Beans	32	34	56	59
Sunflower	18	18	36	37

Using these labor data, average gross returns per acre from each major crop and average gross returns per labor day per acre can be calculated; these are given in Table 8. Note that these are gross returns calculated without subtracting charges for land, inputs or labor. Data in Table 8 indicate that the highest gross returns per labor day come from maize, beans and sorghum and the lowest from cotton. Since the official minimum wage was 13.10 Tsh per day in rural areas at the time, gross returns per labor day from one acre of cotton yielded slightly more than the minimum wage, maize yielded 3.7 times and beans 2.6 times the minimum wage based on the time allocations given by the sampled families.

If these data on gross returns per labor day per acre are used, along with the percentage of labor time allocated between the sexes, to calculate differences between male and female earnings in Kilosa district, males would earn 87.58 Tsh per day growing one acre of all of these crops and females would earn 83.12 Tsh. By this method of calculation, average male productivity is 5 percent higher than female. However, on average females contributed 48 percent of total labor requirements. If the average female gross returns of 83.12 Tsh is adjusted by multiplying by 50 and dividing by 48 (so that average returns are calculated on an equal number of days' worked), average female gross returns per labor day would be 86.58 -- almost identical to the male returns.

Table 8. Average Gross Returns Per Acre and Per Labor Day (in Tsh) by Major Crops, Kilosa, Tanzania, 1980*

Major Crop	Average Yield (kg) Per Acre	Average Gross Returns Per Acre	Average Labor Requirements Per Acre	Gross Returns Per Day Per Acre (Tsh)
Maize	430	1,075	22	48.9
Sorghum	309	927	32	29.0
Rice	326	652	33	19.8
Cotton	254	826	51	16.2
Beans	231	1,155	34	34.0
Sunflower	234	410	18	22.8

*This assumes no charge for land, equipment or labor for any crop.

Available also for the Kilosa area is the utilization of labor by farming operation by major crop (Table 9). Weeding and land preparation were the large users of labor in the farming operation; weeding took 34 and land preparation 31 percent of total labor time, respectively. Almost equal days were allocated to planting and harvesting (27) with only 6 days to marketing of crops. The marketing data are not reliable, in the judgment of the author, as many families recorded no time for marketing when they had sales of produce.[7] Cotton took the largest amount for land preparation and weeding, beans the largest number of days for planting, rice for harvesting and sorghum for marketing. The only spraying was done for cotton (5.7 days per acre).

The percentage of the labor days contributed by females is shown in Table 10. Although females contributed 48 percent of the total labor, they contributed 58 percent of the harvesting, 55 percent of the planting and 52 percent of the weeding. Had the marketing data been more accurately recorded, total female participation probably would have been above 48 percent.

[7] Faculty members at the University of Dar es Salaam, Morogoro stated that 2 days a week per family is spent marketing. It is on this basis and on the basis of sales that I suggest that marketing allocations are underreported.

Table 9. Labor Utilization by Task by Major Crops Per Acre, Sampled Families, Kilosa, Tanzania, 1980

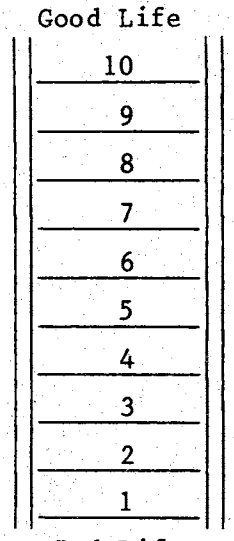
	Maize	Sorghum	Rice	Cotton	Beans	Sunflower	Total
	Number of days						
Land preparation	8.6	9.7	9.3	14.3	11.0	5.6	58.5
Planting	1.9	4.0	5.1	7.7	5.9	2.7	27.4
Weeding/thinning	9.2	10.4	11.4	16.6	11.3	6.4	65.6
Spraying	0	0	0	5.7	0	0	5.4
Harvesting	2.0	5.4	7.3	3.8	5.9	3.4	27.0
Marketing	.3	2.5	0	2.5	.6	.4	6.3
Total*	22.0	32.0	33.1	50.6	34.0	18.5	190.2

*Totals are slightly different from Table 7 due to rounding.

Table 10. Percentage of Labor Days per Acre Contributed by Females by Operation by Crop, Sampled Families, Kilosa, Tanzania, 1980

	Maize	Sorghum	Rice	Cotton	Beans	Sunflower	Total
	%	%	%	%	%	%	%
Land preparation	44	37	61	39	55	34	46
Planting	52	41	77	48	60	40	55
Weeding/thinning	51	43	65	51	59	40	52
Spraying	0	0	0	0	0	0	0
Harvesting	54	46	71	51	69	43	58
Marketing	17	16	50	31	0	12	21
	48	40	67	40	59	37	48

How Do Families Assess Their Level of Well-Being?



An additional set of questions was asked to enable the researchers to know whether farm families believed their level of well-being had improved or deteriorated over time. The scale used was developed by Cantril[8] for use in cross-cultural comparisons; it allows each family to determine their current level of well-being on a scale of 0 to 10; the scale is shown visually in the form of a ladder with the "good life" at the top and the "bad life" at the bottom. Families in Mgeta saw themselves at a slightly higher level of well-being than Kilosa families (5.5 compared with 5.0). Kilosa families believed that they were better off 5 years ago than currently (5.4 compared with 5.0) while Mgeta families saw improvement over the 5 years from 4.8 to 5.5. Both areas expected to be at higher levels of well-being 5 years hence than currently, with Mgeta families the more optimistic (6.9 compared with 5.8). These contrasts are shown in Table 11.

Table 11. Assessment of Average Levels of Well-Being by Sampled Families, Kilosa and Mgeta Districts of Tanzania, 1981 (out of a possible 10)

	Kilosa	Mgeta
Current rung of ladder	5.0	5.5
Level 5 years ago	5.4	4.8
Level 5 years hence	5.8	6.9

[8] Cantril, Hadley, "A Study of Aspirations," Scientific American, Volume 208, No. 2, February, 1963, pp. 41-45.

When families were asked which three items were most important in the "good life", the three mentioned most frequently in Kilosa were a good harvest and enough food, a metal roof on the house, and enough money to live well. In Mgeta a house with a metal roof ranked first, good health and enough food second, and good clothing third. So food and housing are high priority items for these families in both locations.

When ranking priorities of the "bad life", Kilosa families stated consumer goods shortages and high prices, no money or poverty and bad harvests. Mgeta families ranked hunger or food shortages first, a poor house second, and consumer goods shortages and high prices third. Consumer good shortages have been severe in Tanzania in recent years due to foreign exchange constraints and transport difficulties; family members often have to line up for more than an hour to obtain kerosene, milk, and other items.

Variation in value of total production (VTP)

Multiple and bivariate regressions were calculated to determine those factors which accounted for most of the variation in value of total production.

(A) Seventy-four percent of the household heads in Kilosa stated that the major objective of the farming enterprise was to provide adequate food for the family and money to cover other family living expenditures. Thus it was hypothesized that two independent variables, value of total food consumption (X_1) and total cash family living expenditures (X_2) would explain a high degree of the variation in VTP[9]; the equation took the following form:

$VTP = a + b_1X_1 + b_2X_2$ where X_1 and X_2 are measured in shillings[10]

Results of this multiple regression gave the following equation-(with T values in brackets):

$$(1_k)\ VTP_k = -2935 + \underset{(2.7080)}{.8940}\ X_1 + \underset{(7.4772)}{2.6879}\ X_2$$

The resulting R^2 was .61 and both variables were significant ($p < .05$). Thus two variables, the value of food consumption and total cash family living expenditures explained 61 percent of the variation in VTP in Kilosa district.

In Mgeta 67 percent of the families responded that their major objective in farming was an adequate food supply for the family and 28 percent gave income as their primary objective. Results of the regression in Mgeta were:

[9]This is contrary to current consumption theory which states that consumption is primarily dependent on family income.

[10]Remembering that other important variables are omitted temporarily.

$$(1_m)\ VTP_m = 3{,}134 + \underset{(4.8517)}{1.0434X_1} + \underset{(.5612)}{.1011X_2}$$

The R^2 was .37 and only food consumption was significant ($p < .10$).

(B) Since it is obvious that the provision of adequate food for family consumption is an important determinant of value of total production in both areas, it was decided to see if families increased acreage in order to accommodate increased family size. The resulting equation was $X_3 = a + b_4 X_4$ where X_3 is acreage and X_4 total family size[10]. Results for each of the districts were as follows:

$$(2_k)\ X_{3k} = 2.4772 + \underset{(4.1622)}{1.2558\ X_4} \qquad R^2 = .25$$

Thus 25 percent of the variation in acreage is accounted for by size of family; if family size is increased by one person, acreage planted will increased by 1.26 in Kilosa district. While size of family accounts for 25 percent of the variance in acreage, total labor equivalents available accounted for only 15 percent. Thus family size has more influence on total acreage planted than total labor equivalents available.

If one disaggregates labor available by sex, the resulting R^2 remains at .15 and both male (X_5) and female (X_6) equivalents are significant. The equation becomes (with T values in brackets):

$$(3_k)\ X_{3k} = 1.0760 + \underset{(2.3879)}{2.6404\ X_5} + \underset{(2.4210)}{1.9809\ X_6}$$

If one additional adult male is added, acreage planted is increased by 2.64 acres compared with 1.98 if one adult female is added.

In Mgeta, the corresponding equation of acreage and family size showed and R^2 of .0004; thus family size had no significant effect on acreage plante and labor equivalents available accounted for only 3 percent of the acreage variance. This is not surprising since Mgeta families have limited land available and more acreage allocated to crops for sale.

(C) Tanzanian agricultural economists working in traditional agriculture are convinced that labor is the major constraint in increasing agricultural production. If so labor should have a significant effect on the variation in VTP. When total labor (X_7) was used as an independent variable, the resulting equation was:

$$(4_k)\ VTP_k = -611 + \underset{(2.6575)}{2{,}292\ X_7} \quad \text{for Kilosa district.}$$

The resulting R^2 was .12 and labor was significant at the 99 percent level[10]. Thus, in Kilosa district, adding one adult person to the farming enterprise increased VTP by 2,292 Tsh and labor explained 12 percent of the variation in VTP.

In Mgeta, the equivalent regression had an R^2 of .01 and total labor was not significant ($p < .10$).

When labor is disaggregated, and male labor (X_5) is regressed against VTP the resulting equation was

$$(5_k) \quad VTP_k = 2{,}488 + \underset{(1.9277)}{2{,}567}\ X_5$$

The resulting R^2 was .065 and X_5 was significant at the 90 percent level. Thus male labor accounted for only 6.5 percent of the variation in VTP; if male labor is increased by one unit, VTP in Kilosa district is increased by 2,567 Tsh. In Mgeta, male labor was not significant at the 90 percent level.

What is the influence of female labor (X_6) as an independent variable? The R^2 now falls to .037 and X_6 is not significant (significant only at the 84 percent level). Thus female labor explains only 3.7 percent of the variation in VTP in Kilosa district:

$$(6_k) \quad VTP_k = 4{,}429 + \underset{(1.4190)}{1{,}420}\ X_6$$

Thus, if female labor is increased by 1 unit, VTP in Kilosa increased by 1,420 Tsh.

From this analysis, the marginal productivity of female labor is 1,420 Tsh compared with 2,567 for male labor or female labor productivity is 55 percent of male labor productivity in Kilosa district.

In Mgeta district, the R^2 was .02 and female labor was not significant.

(D) What other factors explain significant variations in VTP? One would expect acreage (X_3), total labor available (X_7), education (X_8), experience on the job (number of years farming X_9)[11], operating costs (X_{10}) all to be important variables. In Kilosa, these variables explained .88 of the variation in VTP, with acreage alone explaining .82 and farm

[11] This coefficient was negative and not significant and thus dropped from the equation.

operating costs .06; each of these variables were significant; education had a negative sign and with total labor available, was not significant ($p < .10$).

$$(7_k)\ VTP_k = 1{,}064 + \underset{(4.4962)}{545.78\ X_3} + \underset{(.2521)}{90.03\ X_7} - \underset{(-1.2149)}{101.15\ X_8} + \underset{(5.2271)}{3.60\ X_{10}}$$

In Mgeta, the same variables resulted in the following equation:

$$(7_m)\ VTP_m = 1{,}892 + \underset{(3.6631)}{363.42\ X_3} + \underset{(.8823)}{366.61\ X_7} - \underset{(-.5287)}{12.29\ X_8} + \underset{(1.3839)}{1.72\ X_{10}}$$

In Mgeta these variables accounted for .31 of the variation in VTP; acreage alone accounted for .26, farm operating expenses for .03 and labor for .01; acreage was the only significant variable. Again education had a negative sign.

Thus the conclusion is that acreage is the independent variable which explains most of the variation in VTP followed by farm operating costs; in both areas.

In both areas adding one more shilling of farm operating expenses has a significant effect on value of total production; in Kilosa one additional shilling of farm operating expenses increases VTP by 3.60 Tsh and in Mgeta by 1.72 Tsh.

(E) Since the value of food consumption was such an important determinant of variation of VTP in (A), it was decided to use total value of food consumption (X_1), farm operating expenses (X_{10}), and male (X_5) and female (X_6) labor equivalents as the independent variables affecting the variation in VTP. The resulting equations were:

$$(8_k)\ VTP_k = 474 + \underset{(6.7511)}{1.0580\ X_1} + \underset{(1.5774)}{689.6254\ X_5} - \underset{(-.1558)}{51.3145\ X_6} + \underset{(19.7068)}{5.9038\ X_{10}}$$

In Kilosa these variables explained 92 percent of the variation in VTP but only food consumption and farm operating costs were significant. In Mgeta these variables explained 39 percent of the variation and took the following form:

$$(8_m)\ VTP_m = 3{,}099 + \underset{(4.6250)}{1.1067\ X_1} - \underset{(-.3370)}{239.3978\ X_5} - \underset{(-.5356)}{291.716\ X_6} + \underset{(1.1598)}{1.3687 X_{10}}$$

In Kilosa farm operating costs explained 68 percent of the variation and value of food consumption 17 percent; both male and female labor equivalents were not signficiant ($p < .10$). Thus in Kilosa area, where a few of the samplied families used purchased inputs, an increase of 1 Tsh for farm operating expenses increased VTP by 5.90 Tsh; hence farms are not at equilibrium.

(F) Finally, colleagues at the Harvard-MIT/WID Workshop suggested that in the Kilosa area where labor inputs by sex were available for each crop, a regression be run to determine whether or not VTP varied by the percentage of female labor allocated to crop acreage of each crop (7). The equations took the following form:

$$(9_k)\ VTP = a + bY \text{ where } Y = \sum_{i=1}^{m} \sum_{j=1}^{n} Z_i X_{ij}$$

when Z is the acreage of each major crop grown per family and X_{ij} is the percentage of total labor which is female utilized on each crop acreage. A similar equation was set up for male labor. The results were as follows:

$$(9_k)\ VTP_k = -467 + \underset{(11.9640)}{1659}\ Y \text{ for female labor and}$$

$$(10_m)\ VTP_k = 182 + \underset{(6.7110)}{1571}\ Y \text{ for male labor.}^{10}$$

In 9_k, the R^2 was .73 and in 10_k, it was .46; both male and female labor were significant. Thus 73 percent of the variation in total value of production in Kilosa is explained by the percentage of female labor utilized on the acreage of each major crop grown, and marginal productivity of female labor by this calculation is 6 percent higher than of male labor utilized on crop acreage.

Similar data were not available for Mgeta.

(G) Since acreage of different crops yield differnt amounts of VTP depending on the prices of each crop, one final calculation was made to determine relative average amounts of VTP earned by female labor multiplied by the VTP of each major crop per farm. In other words, instead of using acreage of each major crop, as in (F), VTP of each major crop produced per farm was used. Results were similar to those in (F); (11_k) female labor produced 3,424 Tsh compared with 3,052 Tsh for male labor, on average; thus female labor was 12 percent more productive than male on average.

Summary and conclusions

The focus of this paper was an attempt to compare male and female productivity in two contrasting farming systems in Tanzania. My hypotheses were first, that male and female productivity were equal in each area, and second, that female productivity was much higher in Mgeta (with multiple cropping) than in Kilosa (with single cropping). It turned out that average value of total production per family was almost identical in the two areas, and since

the ratio of females to males was 1.12 to 1.0 in Mgeta compared to 1.0:1.0 in Kilosa, female productivity would not differ markedly in the two areas if they shared equally in farm operations. Thus the second hypothesis is not substantiated until comparable labor utilization data can be gathered for Mgeta. As vegetables are a more labor intensive crop, female labor inputs may be a higher percentage of total labor in Mgeta than in Kilosa.

Data do substantiate the first hypothesis. If one sums the labor days worked per major crop, females provide 48 percent of the labor in Kilosa; similar data were not available for Mgeta. However, females' contribution to major crops varies; they contribute about 48 percent of the maize labor requirements, 67 percent for rice and 59 percent for beans; allocations for sunflower, sorghum and cotton were approximately 40 percent. Females contributed 55 percent of the weeding, 58 percent of the harvesting; and 52 percent of the planting. Since prices received for these crops varied, if one takes female labor contributions multiplied by average value of production of each major crop, female productivity is 5 percent higher than male productivity in Kilosa (equations 9 and 10).

Another way of comparing productivity is to look at those factors that influenced value of total production (VTP) in each area; it was found that these independent variables had the following effect on the variation in VTP (Those variables which were significant ($p < .10$ or lower) are starred, numbers correspond to equations in the text):

		Kilosa R^2	Mgeta R^2
1.	Food consumption* & family living expenses*	.61	.37
4.	Total labor equivalents per family*	.12	.01
5.	Male labor equivalents per family*	.065	N.A.
6.	Female labor equivalents per family*	.037	.02
7.	Acreage*, farm operating expenses*, formal education, male and female labor equivalents	.88	.26
8.	Food consumption*, farm operating expenses* male and female labor equivalents	.92	.39
9.	Female labor* as a percentage of total labor utilized multiplied by acreage of each major crop*	.73	N.A.

	R^2 Kilosa	R^2 Mgeta
10. Male labor* as a percentage of total labor utilized multiplied by acreage* of each major crop	.46	N.A.
11. Female labor* as a percentage of total labor utilized multiplied by VTP of each major crop	3,424 shillings	N.A.
11. Male labor* as a percentage of total labor multiplied by VTP of each major crop	3,052	N.A.

These results can be summarized in terms of this paper as follows: total labor equivalents account for 12 percent of the variation in VTP in Kilosa but only 1 percent in Mgeta; male labor per family accounted for 6.5 percent and female labor 3.7 percent. Value of food consumption, acreage planted, and farm operating expenses were the most significant variables in accounting for variation in VTP. In equations 9 and 10, the addition of one female laborer per family increased VTP by 1,659 Tsh whereas the addition of one adult male laborer increased VTP by 1,571 Tsh[10]. This would estimate marginal female productivity at 106 percent of male, other things being equal. Average productivity of female labor was also 12 percent higher than male productivity (equation 11_k).

There is no doubt that much more research is needed. It is sufficient to conclude and document that women in traditional agricultural production in many parts of tropical Africa not only do the household tasks but contribute significantly to agricultural production; in Kilosa they contributed 48 percent of the total labor. This paper substantiates the equality of female and male marginal labor productivity in Kilosa and documents more fully the importance of females in the farming systems.

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