GENDER DIFFERENTIALS IN AGRICULTURAL PRODUCTIVITY AMONG SMALLHOLDERS IN ADA, LUME AND GIMBICHU *WOREDAS* OF THE CENTRAL HIGHLANDS OF ETHIOPIA

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ABSTRACT

In 1996/97, a survey of 180 farmers (99 male farmers and 81 female farmers) was conducted in Ada, Lume and Gimbichu Woredas in the central highlands of Ethiopia to determine the gender differentials in agricultural productivity among smallholders. The evidence shows that male-headed households had more land, labor, and capital, particularly livestock (cattle), compared to female-headed households. It was also shown that male-headed households had more access to formal education compared to female-headed households. The production function analysis showed that the elasticities for the significant factors affecting the gross value of output of male-headed households were farmers' age (-0.21), fertilizer (0.10), farm-size (0.56),

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labor input (0.23), and livestock (0.13). For female-headed households, the elasticities were fertilizer (0.10), farm-size (0.76), labor (0.18), livestock (0.07), hired labor (0.03), and extension (-0.28). The comparison of the marginal value of the product with the factor-cost showed that male-headed households could increase productivity by using more labor and fertilizer, while female-headed households could do so by using more land and fertilizer. Male-headed households (6456 Birr/ha) had a higher gross output compared to female-headed households (4776 Birr/ha). However, the gross value of the output was 1.3% higher for the female-headed households if the average values of the inputs from male-headed households were used. This suggests that no significant differences would exist if female-headed households had equal access to inputs as male-headed households.

INTRODUCTION

There is a growing recognition that men and women often have very different rights and responsibilities with respect to resource use and decision making. In gender analysis, it is recognized that the roles of women and men are largely determined socially rather than biologically (Rosaldo and Lamphere, 1974). This recognition has resulted in a number of studies documenting the different roles of women and men in various farm, non-farm, food preparation, household maintenance and child-care activities (McSweeney, 1979; Dey, 1981; Whitehead, 1985; Adepoju and Oppong, 1994; Bryceson 1995). Other studies have shown that women and men are faced by differential access to new technology, education, health care and other resources (Ahmed, 1985; Abu and Oppong, 1987; Stamp, 1989).

Furthermore, it has been recognized that both gender and household-based approaches are useful frameworks for targeting policy making and interventions in rural areas (Warner et al. 1997). The transfer and adoption of agricultural technology in particular and the productivity of agriculture in general are affected by who decides what to produce and when to produce and how much to produce. This study attempts to add to the growing empirical evidence on the role of gender in agricultural production. The specific objective of this paper was to assess the factors affecting differences in agricultural productivity between male-and female-headed households in Ada, Lume and Gimbichu *Woredas* of the Central Highlands of Ethiopia. In the study areas, about 90% of the households were, on the average, found to be male-headed, while only 10% were female-headed. Female-headed households were those managed by widows, divorced or single women without the mediation of husbands, and fathers or male relatives in the routine day-to-day activities of those households. Male-headed households were those where husbands were final decision-makers in important issues pertaining to the households (Starkey et al., 1994).

THE STUDY AREA

Ethiopia is the largest producer of wheat (both durum and bread) in sub-Saharan Africa (SSA), accounting for over half the total wheat growing area (Hailu et al., 1999; Workneh et al. 1994). About 64% of the area and 69% of the production of wheat is concentrated in the central and northern regions of the country. Tetraploid wheat (durum-indigenous to Ethiopia) is produced predominantly in the highlands of Shewa, Gojam, Bale and Arsi while bread wheat is grown mainly in the Bale and Arsi highlands covering about 60% and 50% of the total national wheat area respectively (Tesfaye and Getachew, 1991).

Ada, Lume and Gimbichu *Woredas* covered in this study are found in the central highlands where wheat is predominantly grown. Ada *Woreda*, which is about 40 km southeast of Addis Ababa, covers 1750 sq. km. The largest part of it (66%) lies 1800 m above sea level (Gryseels and Anderson, 1983). Much of the land in Ada is eroded and poorly drained. July and August are the wettest months while April and May are the hottest ones. The major crops grown are teff, wheat, barley, faba bean, chickpea and lentils (Workneh, 1989). Lume *Woreda* is found north-east of Debre Zeit at an altitude ranging from 1700 to 2100 m. July and August are the wettest while April, May and June are the hottest months. The major crops grown are teff, wheat, haricot bean, maize, chickpea, barley and faba bean. Gimbichu *Woreda*, on the other hand, lies at an average altitude of 2450 m, bordering Ada on the northern side of Debre Zeit. July and August are, on the average, the wettest months. The major crops grown are wheat, teff, chickpea and faba bean. The major soil type in all three *Woreda*s is vertisol.

METHODOLOGY

Data collection

Multi-stage random sampling was used to select development centres and Peasant Associations (PAs) in all the three *Woreda*s. In each *Woreda*, six development centres were purposively selected on the basis of accessibility.

For each *Woreda*, the sample frame constituted all female- or male-headed households of the six development centres. Out of each development centre, six female- and male-headed households were randomly selected, which added up to a sample of 180 households. Out of the ninety-nine households, (55%) were male-headed, while eighty-one (45%) were female-headed households. The gender-disaggregated data were collected in 1996/97. The data were collected using a structured questionnaire in addition to multiple visits made to capture all farming activities during the cropping season. The households were homogeneous in the types of crops they grew and farming operations they carried out. The data analysis was done using SPSS Version 6.1.

Analytical framework

Overcoming agricultural stagnation and food insecurity hinges on increasing agricultural productivity. In many parts of SSA, where subsistence agriculture predominates, placing strong emphasis on increasing the productivity of labor, land, capital and other resource inputs is of paramount importance. Agricultural productivity could also be determined by gender differences if they (men and women) use different technologies or different quantities of factors, or there are differences in the quality of these factors (Saito, 1994). A Cobb-Douglas production function was used to analyze gender differences in agricultural productivity in Ada, Lume, and Gimbichu. It is hypothesized that the use of improved wheat varieties is influenced by combined (simultaneous) effect of a number of factors related to farmers objectives and constraints (CIMMYT, 1993). The variables were hypothesized positively as denoted by (+), negatively (-), or the variable can have a positive or negative effect (+/-) to influence the adoption of improved wheat varieties. According to Saito (1994), the mathematical representation of the Cobb-Douglas production function can be specified as:

$$Y_i = E_{0,i} * X_{1,i}^{E1,i} * X_{2,i}^{E2,i} * \ldots * X_{10,i}^{E10,i}$$

i=1,2 (1=male-headed household; 2=female-headed household)

Where:

Y	=	Gross value of farm output in Birr[1] ;
X_1	=	Age of the household head, years (+/-);
X_2	=	Total amount of family labor used for agricultural production, (family labor consists of following weight factors (male and female (1.0), children (0.5)) hours/year (+);
X_3	=	Farm size, ha (+);
X_4	=	Number of tropical livestock units (TLU consists of following weight factors: cattle (1.0), goat (0.14), sheep (0.14), donkey (0.43), and poultry (0.02)) (+);
X_5	=	Amount of inorganic fertilizer used (kg N/ha) (+);
X_6	=	Quantity of herbicide (liter/ha) (+);
X_7	=	Quantity of insecticide (liter/ha) (+);
X_8	=	Hired labour used for agricultural production, hours/year (+);

[1] The output is calculated as the farm gate price multiplied by yields (including straw yields). The crops included in the total output were barley, chickpea, faba bean, field pea, lentil, maize, rough pea, teff, and wheat.

X_9	=	Extension contact, dummy variable (0=no contact; 1=contact) (+);
X_{10}	=	Education of the household head, dummy variable (0=illiterate; 1=literate (+);
E_0	=	Constant;
E_i's	=	Estimated parameters

The Cobb-Douglas production function is used widely due to a nu ber of desirable properties. One of these desirable properties is that Ei's are the elasticities of output with resnect to the relevant input. A critical assumption is that Ei's are positive and each is less than one. The sum of Ei's also provides the returns to scale parameter. Another attractive property of the Cogg-Douglas production function is that, econometrically, it is easy to estimate because in its log form the parameters are linear and can be estimated easily by using the Ordinary Least Square (OLS) method. However, it has limitations since it treats input choices as exogenous; hence it is susceptible to management bias. Ideally, input choices should be modeled simultaneously with the production function but this usually requires price variation. In addition, the Cobb-Douglas production function is not flexible for modeling complements and substitutes such as the relationship between land and labour or the role of labour availability in choosing variable inputs (Saito, 1994).

SOCIO-ECONOMIC CHARACTERISTICS AND INPUT DIFFERENCES

A summary of the socio-economic and input characteristics of male-and female-headed households is shown in Table 1. The average household size of male-headed households was 7.9 persons compared to 5.8 persons in female-headed households; this difference was significant ($t=5.9$; $p<0.01$). The amount of labor applied for annual agricultural production was significantly higher for male-headed households (1661 hours) compared to female-headed households (1263 hours) ($t=4.5$; $p<0.01$). Also, the amount of hired labor applied for annual agricultural production was significantly higher for male-headed households (505 hours) compared to female-headed households (197 hours) ($t=2.4$; $p<0.05$). In general, female-headed households have been found to be smaller in size in comparison with other households in developing countries (Buvinic and Gupta, 1997). This implies that the male-headed households might have more labor available than female-headed ones. Furthermore, it has been observed elsewhere in Africa that female farmers also tend to limit their labor-time in farm activities due to heavy commitment to domestic chores (Chipande, 1987).

The average age of male household heads was 47.5 years compared to 47.2 years for female household heads (Table 1). This difference was not significant. About 86% of the female-household heads were illiterate, about 12% attended literacy classes while around 1% had primary and secondary education. In contrast, about 63% of male-household heads were illiterate, 25% had attended literacy classes while 10% and about 2% had primary and secondary education, respectively. In general, there was a difference in terms of access to education between male- and female-household heads. Other studies have found similar results. For instance, in Uganda more than half of the women-household heads had received no schooling compared to less than a quarter of their male counterparts (Appleton, 1996), while in Tanzania 96% of male-headed households had some formal education while 82% of female-headed households had no formal education (Bisanda and Mwangi, 1996). Hence, due to their higher education, male-headed households tend to have higher productivity as they are better able to decode new production technology than female-headed households. All female-headed households had farming as their main occupation since their poor educational background did not allow them to be competitive in the off-farm labor market. Hence, policies that encourage women education might lead to higher access to economic opportunities by female-headed households. About 22% of the female-headed households had an extension visit compared to 37% of the male-headed households. This difference was significant ($p<0.05$).

The male-headed households (3.0 ha.) had a significantly larger farm-size than female-headed households (2.4 ha.) ($t=2.6$; $p<0.01$). Studies from five countries in Africa show that women-headed households have smaller land holdings and cultivate from 31 to 74% of the land cultivated by male-headed households (Quisimbing 1993). In Nigeria, male-headed households cultivate three times the farm-size of female-headed households, and male-headed households had double the land per capita of female-headed households. Also, female-headed households in Kenya farm much smaller plots compared to male-headed households (Saito, 1994). Lack of access or control over land affects farm productivity in a number of ways. First, as banks often require land as collateral for credit, lack of title constrains women's access to credit. Furthermore, tenure insecurity has been shown to reduce risk-taking and willingness to make long-term investments that are needed to enhance productivity (Mehra 1994) and ownership. This could be due to the nature of land ownership system in the study area. Traditionally, in Oromo culture women could only have access to land through marriage and even a widow's land still belonged to the husband. However, there has been a policy change which allows PAs to allocate land to female-headed households. In general, there is no overt discrimination of women by law in Ethiopia with regard to land inheritance, ownership and management of land, but the rights of women have not been asserted forcefully in the major legislation (Daniel, 1980).

Male-headed households (6.0) had significantly more livestock units compared to female-headed households (4.9) ($t=1.9$; $p<0.1$). Male-headed households (N 63.5 kg/ha) used significantly more inorganic fertilizer compared to female-headed households (N 44.3 kg/ha) ($t=4.0$; $p<0.01$). Also, male-headed households used significantly more herbicides (0.62 liter/ha) and insecticides, (0.15 litre/ha) compared to female-headed households, who used 0.43 and 0.07 liter/ha of the same, respectively. These differences were significant at $p<0.05$. In general, male-headed households had more access to inputs compared to female-headed households. Tiruwork (1998) and Dejene (1994) found similar results for Ethiopia.

Table 1. Socio-economic and Input Characteristics of Female-and Male-headed Households in Ada, Lume and Gimbichu, 1996/97

	Female-headed households (N=81)	Male-headed households (N=99)	T-statistic
Household size (no.)	5.8	7.9	5.9*
Labor (hours/year)	1263	1661	4.5*
Hired labor (hours/year)	197	505	2.4**
Age of household head, yrs.	47.2	47.5	0.13 (NS)
Access to education (%)	14.4	37.2	
Farming as main occupation (%)	100	97	
Extension contact (%)	21.8	37.0	4.8**
Farm size (ha.)	2.4	3.0	2.6*
Livestock units (number)	4.9	6.0	1.9***
Inorganic fertilizer (N in kg/ha)	44.3	63.5	4.0*
Herbicides (liter/ha)	0.43	0.62	2.2**
Insecticides (liter/ha)	0.07	0.15	2.1**

Note: T-Statistics are in brackets; NS = Not Significant; * = significant at $p<0.01$; ** = significant at $p<0.05$; *** = significant at $p<0.1$

GENDER DIFFERENCES IN AGRICULTURAL PRODUCTIVITY

The estimates of the Cobb-Douglas production function by gender in Ada, Lume and Gimbichu are shown in Table 2. The coefficients of multiple determination adjusted for degrees of freedom indicated that the variation in gross value of output per hectare associated with the factors of production specified in the model was 72 and 82% in male-and female-headed households, respectively.

The significant factors affecting gross value of output per hectare for male-headed households were farmer's age, family labor, farm-size, livestock units, and inorganic fertilizer. The significant factors affecting gross value of output per hectare for female-headed households were family labor, farm-size, livestock units, inorganic fertilizer, hired labor, and extension contact.

For male-headed households, farmer's age had a significant and negative impact on the gross output. A 10% increase in farmer's age resulted in a 2.1% decrease in gross output. Family labor had a significant and positive impact on the gross output for both male-and female-headed households. A 10% increase in the amount of labor resulted in a 2.3% and a 1.8% increase in gross output for male-and female-headed households, respectively. Farm-size had a positive and significant impact on the gross output of male- and female-headed households. A 10% increase in the farm-size resulted in a

5.6% and a 7.2% increase in gross output for male- and female-headed households respectively.

The number of livestock had a positive and significant impact on the gross output of male-and female-headed households. A 10% increase in the number of livestock for male-and female-headed households resulted in a 1.3% and 0.7% increase in gross output respectively. The amount of inorganic fertilizer used had a positive and significant impact on the gross output of male- and female-headed households. A 10% increase in the amount of fertilizer for both male- and female-headed households resulted in a 1.0% increase in gross output. Saito (1994) found that the use of inorganic fertilizer on female plots in Kenya increased the gross output by 1.6% compared to 1.3% for male plots.

The amount of hired labor for agricultural production had a positive and significant impact on the gross output of female-headed households. This impact was only very marginal because a 10% increase in the amount of hired labor resulted in a 0.03% increase in gross output. Extension services had a negative and significant impact on the gross output for female-headed households. The gross output was lower for the female-headed households that had contact with extension services. This can be explained by the significant lower access to extension of female-headed households compared to male-headed households. Moock (1976) also found that extension services had a negative impact on farming for women farmers.

Table 2. Estimates of Cobb-Douglas Production Function by Gender in Ada, Lume and Gimbichu *Woreda*s, 1997

	Male-headed households		Female-headed households	
	Regression coefficient (E)	T-statistic	Regression coefficient (E)	T-statistic
Intercept	6.6271	9.41*	6.3330	8.38*
Age of the household head (years)	-0.2112	1.80***	-0.0817	0.74
Family labor (hours/year)	0.2342	2.54**	0.1809	2.05**
Farm size (ha.)	0.5592	7.46*	0.7551	10.49*
Tropical livestock units (number)	0.1332	2.67*	0.0719	1.63***
Inorganic fertilizer (kg. N/ha)	0.1012	1.69***	0.1027	1.92***
Quantity of herbicide (liter/ha)	0.0679	1.36	0.0386	0.54
Quantity of Insecticide(liter/ha)	0.0367	0.43	0.1520	0.89
Hired labor (hours/years)	-0.0007	0.05	0.0278	2.56**
Extension contact (dummy)	-0.0461	0.77	-0.2844	4.04*
Education of the household head (dummy)	-0.0288	0.44	-0.0922	1.48
Adjusted R^2	0.72		0.82	
F-test	26.2*		35.8*	
Sample size (N)	100		77	

Note: ***= Significant at p<0.1; ** = Significant at p<0.05; *= Significant at p<0.01

The allocative efficiency can be determined by comparing the marginal value product (MVP) of a factor with its opportunity cost (factor price). The MVP of a factor is the additional return from adding one more unit of that factor holding all other inputs constant. In this study, we have calculated the MVP using a 10% increase in the use of that factor. An MVP which exceeds its opportunity cost suggests that there is scope for productivity raising output by increasing the use of that factor. Conversely, increasing the use of a factor which has an MVP less than the associated opportunity cost decreases the productivity.

The MVP for family labor, farm-size, and amount of fertilizer were determined for male-and female-headed households. Table 3 shows the MVPs and factor prices for the significant variables for male- and female-headed households using a 10% increase in the actual use of the respective inputs. Thus, for female-headed households 126.3 hours (10% of 1263 hours/year) were added. The factor price was then calculated using a daily wage rate of 5.5 birr/day. The duration of a working day was 8 hours. The factor prices for farm-size and fertilizer were calculated by using the average rent (311 Birr/kert) and actual fertilizer prices (5.2 Birr per kg of N/ha) respectively. These prices were multiplied by a 10% increase of farm-size (0.3 and 0.24 ha for male-and female-headed households) and fertilizer use (6.4 and 4.4 kg N/ha for male-and female-headed households) respectively. The MVP of family labor in male-headed households is higher compared to its price (wage rate); however, it is lower in female-headed households. This means that male-headed households could increase their productivity by using more family labor. A study by Quisumbing (1993) also found that the marginal product of women's labor was lower than that of men. Also, Quisumbing (1996) attests to this fact by citing a study in India, where the marginal product of male labor is greater than that of female labor.

For male-headed households, the MVP of farm-size was lower than its factor price while it is higher for female-headed households. Thus, female-headed households could increase their productivity by cultivating more land. The MVP for inorganic fertilizer was higher than its factor-cost for both male-and female-headed households which indicates that both households would increase their productivity by increasing their use of inorganic fertilizer.

The gender difference in gross output was considerable. Male-headed households had a gross output of 6456 Birr/ha. while female-headed households had 4776 Birr/ha. These differences can be explained partly by the lower quantities of inputs used by the female-headed households. Table 3 already showed that significant differences exist in the use of land, labor, fertilizer, herbicides, insecticides, livestock, and hired labor. Therefore, the average values of these inputs from the male-headed households were used to predict the gross output for the female-headed households. This resulted in a gross output of 6541 Birr/ha, which is 1.3% higher compared to male-headed households. This suggests that no productivity differences exist between male-and female-headed households if they had equal access to inputs. A study by Moock (1976) in Kenya also showed that women obtained 6.6% more output at the mean levels of input compared to men. Satio (1995) found that women in Kenya obtained about 22 % more output compared to men when they had equal access to resources as men did.

Quisumbing (1996), however, reported that these simulations should be interpreted with caution since we do not know how the levels of inputs could be raised for female-headed households.

Table 3. MVP and Factor Prices (in Birr) for the Significant Variables for Male-and Female-Headed Households

	Male-headed households		Female-headed households	
	Marginal Value of Product	Factor Price	Marginal Value of Product	Factor price
Family labor (hours/year)	145.7	114.7	82.1	86.7
Farm size (ha.)	353.4	373.2	356.3	298.6
Inorganic fertilizer (kg. N/ha)	62.6	33.3	47.0	22.9

CONCLUSION

The results show that male-headed households had more land, labor, and capital (particularly livestock), fertilizer, herbicides and insecticides compared to female-headed households. It was also shown that male-headed households had more access to formal education compared to female-headed households.

The production function analysis showed that the elasticities for the significant factors affecting the gross value of output for male-headed households were farmer's age (-0.21), fertilizer (0.10), farm-size (0.56), labor (0.23), and livestock (0.13). For female-headed households, the elasticities were fertilizer (0.10), farm-size (0.76), labor (0.18), livestock (0.07), hired labor (0.03), and extension (-0.28). The negative elasticity for extension implies that policy makers and the Ministry of Agriculture should specifically target female-headed households in order to mitigate its negative effect on gross value of output for female-headed households.

The comparison of the marginal value of the product with the factor-cost showed that male-headed households could increase productivity by using more labor and fertilizer, while female-headed households could do so by using more land and fertilizer. Male-headed households (6456 Birr/ha) had a higher gross output than female-headed households (4776 Birr/ha). However, the gross value of the output was 1.3% higher for female-headed if the average values of the inputs from male-headed households were used. A study by Tiruwork (1998) concluded that male-headed households were significantly more productive than female-headed households. This study agrees that male-headed households had a higher productivity, but concludes that no significant differences would exist if female-headed households had equal access to inputs as male-headed households. Therefore, policy makers should promote policies that improve access to inputs like land, labor, fertilizer, herbicides, insecticides, and livestock for female-headed households because this will increase overall productivity.

REFERENCES

Abu, K. and C. Oppong, 1987. Seven Roles of Women: Impact of Education, Migration and Employment on Ghanaian Mothers. *Women, Work and Development* Series No. 13. Geneva: ILO

Adepoju, A., and C. Oppong. 1994. Gender, Work and Population in Sub-Saharan Africa. London: James Currey.

Ahmed, I. 1985. Technology and Rural Women: Conceptual and Empirical Issues. London, Boston and Sydney: George Allen and Unwin.

Appleton, S. 1996. Women-Headed Households and Household welfare: An Empirical Deconstruction for Uganda. *World Development*. Vol. 24, No. 12, pp. 1811-1827.

Bisanda S., and W. Mwangi. 1996. Adoption of Recommended Maize Technologies in Mbeya Region of the Southern Highlands of Tanzania. Addis Ababa: CIMMYT/ The United Republic of Tanzania, Ministry of Agriculture.

Bryceson, D.F. 1995. Women Wielding the Hoe. Lessons from Rural Africa for Feminist Theory and Development Practice. Oxford: Berg.

Buvinic, M., and G.R. Gupta. 1997. Female-Headed Households and Female-maintained Families: Are they worth targeting to reduce poverty in developing countries? *Economic Development and Cultural Change.* Vol. 45, No.2, pp. 259-280.

Chipande, G.H.R. 1987. Innovation Adoption Among Female-Headed Households: The Case of Malawi. *Development and Change.* 18:315-27.

CIMMYT Economics Program. 1993. The Adoption of Agricultural Technology: A Guide for Survey Design. Mexico, D.F.: CIMMYT.

Daniel Haile. 1980. Law and the Status of Women in Ethiopia: UN/ECA, ATRCW, Addis Ababa.

Dey, J. 1981. Gambian Women: Unequal Partners in Rice Development Projects. *Journal of Development Studies.* 17 (3): 109-122.

Dejene Aredo, 1994. Female-headed Households in Two Contrasting Regions in Ethiopia: Access to and Management of Resources. *Ethiopian Journal of Development Research*, Vol. 16. No.1. Addis Ababa.

Gryseels, G., and F.M. Anderson. 1983. Research on Farm and Livestock Productivity in the Central Ethiopian Highlands: Initial Results 1977-1980. ILCA Research Report No.4, ILCA, Addis Ababa.

Hailu Beyene, Franzel, S., and W. Mwangi. 1990. "Constraints to Increasing Wheat Production in Ethiopia's Smallholder Sector." pp. 284-293. In: Tanner, D.G., van Ginkel, M., and W. Mwangi (eds). Sixth Regional Wheat Workshop for Eastern, Central and Southern Africa. Mexico, D.F.: CIMMYT.

McSweeney, B.G. 1979. Collection and Analysis of Data on Rural Women's Time Use. Studies in Family Planning.

Mehra, R. 1995. "Raising Agricultural Productivity: The Role of Women Farmers." pp. 387-402. In: Peters, G.H., and D.D. Hedley (eds). Twenty-Second Conference of Agricultural Economics. International Association of Agricultural Economics (IAAE). University of Oxford.

Moock, P.R. 1976. The Efficiency of Women as Farm Managers in Kenya. *American Journal of Agricultural Economics*, December 1976: 831-835.

Quisumbing, A.R. 1993. Improving Women's Agricultural Productivity as Farmers and Workers. Paper prepared for a special study on Women in Development. April 1993. Washington DC: World Bank.

____, A.R. 1996. Male-Female Differences in Agricultural Productivity: Methodological Issues and Empirical Evidence. *World Development* 24 (10): 1579-1595.

Rosaldo, M., and L. Lamphere. 1974. Women, Culture and Society. Stanford, CA: Stanford University press.

SPSS Version 6.1. 1991. SPSS Inc. Chicago, IL.

Saito, K.A., Hailu Mekonnen, and D. Spurling. 1994. Raising the Productivity of Women Farmers in sub-Saharan Africa. *World Bank Discussion Papers*: 230, World Bank, Washington.

Stamp, P. 1989. Gender, Power and Technology. Ottawa: IDRC.

Starkey, P., E. Mwenyae, and J. Stares. 1994. "Improving Animal Traction Technology." In: Proceedings of the First Workshop of Animal Traction Network for Eastern and Southern Africa, 18-23 January 1992, Lusaka, Zambia.

Tesfaye Tesema and Getachew Belay. 1991. "Aspects of Ethiopian *Tetraploid* Wheat with emphasis on Durum Wheat Genetics and Breeding Research." In: Hailu Gebre Mariam, Tanner, D.G., and Mengistu Hulluka (eds). 1991. Wheat Research in Ethiopia: A Historical Perspective. Addis Ababa: IAR/CIMMYT. pp.47-71.

Tiruwork Tizazu. 1998. Access to Resources and Productivity of Female-headed Households: The case of East Gojam and North Shewa Zone. Unpublished MA thesis. University of Addis Ababa.

Warner, M.W., R.M. Al-Hassan, and J.G. Kydd. 1987. Beyond Gender Roles? Conceptualizing the Social and Economic Lives of Rural Peoples in Sub-Saharan Africa. *Development and Change*, Vol. 28: 143-168.

Whitehead, A. 1985. "Effects of Technological Change on Rural Women: A Review of Analysis and Concepts." In: I. Ahmed (eds.). Technology and Rural Women: Conceptual and Empirical Issues, pp. 27-64. London, Boston and Sydney: George Allen and Unwin.

Workneh, N. 1989. Diagnostic Survey of the Farming Systems in Ada, Lume and Akaki (Unpublished). AUA/DZARC. Debre Zeit.

Workneh, N. Mwangi, W., and Tesfaye Tessema. 1994. Cultural Practices and Varietal Preferences for Durum Wheat by Farmers of Ada, Lume and Gimbichu *Woredas* of Ethiopia. *Research Report Series* No.1. AUA, DZARC, Debre Zeit.