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Twenty-Five Years of Research on Women Farmers in Africa: Lessons and Implications for Agricultural Research Institutions

with an Annotated Bibliography

Cheryl R. Doss

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Contents

Abstract

Based on an extensive review of the literature on women farmers in Africa, this paper explores the potential reasons why women farmers have not adopted improved maize technologies and discusses the implications for agricultural research. Women farmers are often constrained by their lack of access to labor, land, and inputs. In addition, women may prefer different outputs than men. Finally, the dynamics of household decision-making affects technology adoption; roles and responsibilities within the household are often renegotiated when new technologies are adopted, and women may be reluctant to provide labor if they do not receive some of the benefits. Each section of this paper includes a number of questions that may provide insights into the gender roles and dynamics in a particular community. Three general conclusions can be drawn from the available literature. First, there is enormous complexity and heterogeneity among African households. Second, there is no simple way to summarize gender roles within African households and communities. Third, gender roles and responsibilities are dynamic; in particular, they change with new economic circumstances. An extensive annotated bibliography on gender issues and the adoption of maize technologies in Africa follows the review of studies.

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Introduction

For years, activists, donors, and researchers have pushed the International Maize and Wheat Improvement Center (CIMMYT) and other centers of the Consultative Group on International Agriculture Research (CGIAR) to do a better job of targeting their research toward women, especially toward women farmers in Africa. However, the use of high-yielding varieties of maize and the adoption of improved maize management systems in Africa continue to be limited by choices and constraints at the household level, frequently related to gender. After twenty-five years of research on gender issues in African agriculture, we have learned many lessons. We know that "gender matters" and, as this paper demonstrates, we understand many of the dimensions along which it matters. Gender affects farmers' access to labor, land, and other agricultural inputs. Gender may also affect farmers' preferences concerning outputs. We also know that gender relations are dynamic and respond to economic incentives and opportunities. We have relatively little ability, however, to predict *a priori* what the dynamics of technology adoption will be within households and communities. Nor can we predict how the introduction of new technologies will affect the new patterns of labor, land, and resource allocation between men and women.

This paper reviews previous literature on the constraints facing African smallholder farmers, with explicit attention devoted to the different constraints faced by men and women. In particular, it examines the literature on labor allocation, access to land, access to other inputs, preferences regarding outputs, and household decision-making.

Three general conclusions can be drawn from the available literature. First, there is enormous complexity and heterogeneity among African households. Few lessons are transferable across villages, much less across the continent. Rather, the available literature tells us what issues may be important in different contexts and what questions need to be asked in any given location. Thus, it provides detailed information about the dimensions along which gender may matter.

Second, there is no simple way to summarize gender roles within African households and communities. If we seek to understand gender dynamics, it is not sufficient—although it may be useful—to compare male and female farmers or male- and female-headed households. Instead, we need to understand entire systems of household behavior as they are embedded in the agricultural and nonagricultural economies. This is a forbiddingly complex problem, but we must recognize that technology adoption and technology impacts depend on intricate webs of interaction that defy simple generalizations.

Third, gender roles and responsibilities are dynamic. In particular, they change with new economic circumstances. Thus, it is difficult to tell *a priori* what the effects of a particular program will be on a group of people. As the opportunities for one group of people increase—whether they are women, children, or smallholder farmers—their relationships with others in their households and communities are renegotiated. In this vein, the studies reviewed in this paper provide some insights into possible effects in given contexts and to factors that may be important. It is clear that individuals within the household or community who have more power and access to resources are initially better able to take advantage of new circumstances, regardless of who is targeted by a project or program. Thus, it is difficult to target programs and technologies toward women or other groups.

Together, these three lessons provide a challenge for an agricultural research institute concerned with bettering the lives and livelihoods of African agricultural households.

Due to the complexity of household strategies and dynamics, it will be difficult for a research institute to design technologies that will necessarily benefit women or other target groups in particular. This does not imply that research organizations should ignore gender analysis or gender issues. Instead, research organizations can strive to understand how gender may affect the adoption and impact of new technologies. This paper reviews a large number of studies on African agriculture and concludes that access to land, labor, inputs and outputs, and the decision-making power within the household may affect decisions about technologies. Each section of the paper shows how gender can be included in analyses of technology adoption and impacts. The conclusion of the paper outlines some ways in which our understanding of gender issues can shape the activities of CIMMYT and other agricultural research organizations.

Labor

The willingness to adopt new technology depends, in part, on the farmer's expectations for increased output or the alleviation of constraints resulting from its use. One such constraint is the lack of access to labor. A number of factors bear on a household's labor constraints, including the gender division of labor, access to household labor, and access to hired labor. Different crop technologies may require concentrations of labor at different times during the growing season. To the extent that men and women perform different tasks or have different access to outside resources, the gender of the farmer may affect the adoption of technology.

Labor allocation issues have received the most attention in studies of the effects of gender on the adoption of new technologies and increased agricultural productivity. Many studies have tried to explain differences in the gender division of labor across areas and across regions. Boserup's early work described Africa as the area where female farming was the prevalent mode of agricultural production, claiming that female farming occurs in areas that are sparsely populated and where shifting cultivation is used (Boserup 1970). Burton reviews many of the early anthropological works on the gender division of labor. He claims that the most important predictors of women's contribution to agriculture are the number of dry months and the importance of domesticated animals to subsistence; crop type and use of the plow are less important (Burton and White 1984). These generalizations, however, do not provide us with a serviceable framework for understanding the diverse patterns of labor allocation found in Africa.

Gender Division of Labor

In many places in Africa, traditionally there has been a strict division of labor by gender in agriculture. This division of labor may be based on crop or task, and both types of division of labor by gender may occur simultaneously. Women may mobilize male labor for some tasks involved in their crops and men frequently mobilize women's labor for crops that they control. These divisions are not static and may change in response to new economic opportunities.

Division by crop

In some areas, men and women may tend to grow different crops (see Udry [1996] and Hoddinott et al. [1995] for discussion on Burkina Faso). One frequently made distinction is that cash crops and export crops are "male crops," while subsistence crops are "female crops" (e.g., Kumar 1987; Randolf 1988; Koopman 1993). The standard explanation for the division of crops by gender is that women are responsible for feeding the family and thus prefer to grow subsistence crops for household consumption. Men involved with agriculture, on the other hand, are responsible for providing cash income and so are said to grow cash and export crops. In general, however, it is difficult to tell whether women grow lower-value subsistence crops because they have different preferences and concerns or because they have limited access to land, inputs, credit, information, or markets.

The situation with maize is particularly complicated. Maize may be grown as both a cash and a subsistence crop. High-yielding varieties were introduced in many areas to help generate a marketable surplus, but many of these varieties had different processing, cooking, and storage characteristics than the local varieties. The high-yielding varieties were often promoted as cash crops. Consequently,

in many places, local varieties tended to be considered "women's crops" and high-yielding varieties tended to be "men's crops."[1] This implies that not only the crop, but the variety of a given crop, may vary by gender. To the extent that high-yielding varieties are a cash crop and local varieties are a food crop, they may continue to fit into this pattern. However, as high-yielding varieties that meet the consumption preferences of smallholder farmers are developed, the distinctions between subsistence and cash varieties may become blurred. Recent evidence from Malawi suggests that both hybrid maize and local maize can be viewed as either a subsistence or a cash crop, depending on the farmer's circumstances (Smale and Heisey 1994a). As markets based on food for local consumption develop, the definitions of cash versus subsistence crops become less clear. Currently, women frequently are involved in marketing crops for consumption by urban markets (Guyer 1980; von Braun and Webb 1989).

It is important to define what is meant by a crop being a man's or a woman's crop. Cropping involves numerous stages, each involving a variety of decisions and the use of inputs. Frequently, calling a crop a man's or a woman's refers to the gender of the farmer who controls the output. This may not be the only distinction, however, for the purpose of understanding technology adoption. It is also important to consider who makes the decisions about which crops to grow, on which plots of land, and what inputs, including labor, to use. Decisions about labor inputs include whose labor will be used and whether to use outside labor. Different people may be involved with any given crop.

Although there may be some cases in which the adoption of a crop variety is conditioned by traditional notions of appropriate crops for men and women, there is increasing evidence that these norms change as economic circumstances shift. Thus, we would expect to see women adopting modern varieties of maize when it is appropriate for them to do so. As the modern varieties incorporate more of the desired characteristics for home consumption, we would expect to see them being grown for subsistence as well as cash.

Division by task

In most parts of the world, men and women tend to work at different tasks. Numerous time allocation studies have examined the issue of which household members perform which farm tasks (McSweeney 1979; Pala 1983; Hirschmann and Vaughan 1984; Saito 1994). These studies often identify some tasks as men's tasks and some as women's tasks. For example, in Kenya, women reported that men were responsible for building the granary, while women were clearly responsible for hand digging, harvesting, and transporting the crops (Pala 1983). However, though tasks may be viewed as women's or men's, in practice, the divisions are blurred with both men and women involved in many tasks. Relatively few tasks are done only by men or only by women.

Many studies examining time allocation across agricultural and nonagricultural tasks find that women work more hours than men (Saito 1994).[2] Time allocation by gender can be determined in two ways. One is by asking household members about their contributions to each task. The other approach is through observation, in which the time allocation of individual household members is recorded by an outside observer—obviously a much more time-intensive and costly process. In a time-allocation study in Burkina Faso, data on rural women's time use obtained using the two techniques were compared. Some 44% of women's work was unaccounted for using recall (McSweeney 1979). Similar comparisons for men were not made, so it is not clear how the bias affects the *relative* amounts of work attributed to women and men.

Labor inputs may also be affected by farm size and other farm characteristics. In Zambia, as farm size increases, women (on a per capita basis) allocate more labor to both household maintenance and agriculture, while men work slightly less in agriculture and much less in nonagricultural activities (Kumar 1991).

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[1] For example, Gladwin (1992) suggests that local varieties of maize in Malawi are primarily women's crops while cash crops and export crops, such as tobacco and hybrid maize, are men's crops. In Zambia, local maize is often considered a woman's crop (Alwang and Siegel 1994).

[2] Saito finds that women work more hours than men in agriculture in Burkina Faso, Kenya, Zambia, and Nigeria.

That women throughout Africa tend to provide more labor for agriculture than men—and almost always provide more total labor—has implications for technology adoption. Even if productivity is increased, women may not be able to increase the number of hours that they spend working. Simply comparing hours worked also does not capture the issues of the type of work being done and the energy expended. The value of time will vary across seasons and tasks, thus people will be interested in saving the time that is the most costly (Levi 1987). However, to the extent that the tasks vary by gender and the value of women's time is lower, farmers may be more inclined to adopt technologies that save men's time.

Changes in the division of labor

Although tradition often specifies some tasks or crops as women's and some as men's, these may change over time. As early as 1928, Baumann noted that as the opportunities for men to work outside of agriculture increased, women's involvement in agriculture also increased (Baumann 1928). With new opportunities arising, gender divisions of labor in many places are becoming less rigid (Kranz and Fiege 1983; Alwang and Siegel 1994; Donhauser et al. 1994; Saito 1994). Many changes in the gender division of tasks are related to increasing outmigration of men from agricultural communities, as they seek higher earnings elsewhere. As men leave the area, women take over many of the traditionally male tasks. Joluo women in Kenya reported that at the time they were interviewed, they performed more tasks that were considered traditionally "male" than when they were first married and moved into the area (Pala 1983). In addition, when men move into nonfarm activities, women may become more involved in cash cropping.

Although the gender division of labor may be changing, it does not appear that men are taking over women's agricultural activities, specifically, the production of food for home consumption. When men move into activities that are traditionally women's, they usually are not substituting their labor for their wives' labor within the household. Rather, usually some new opportunity has arisen and activities that had been considered women's activities have become more productive or profitable. For example, in Burkina Faso, women traditionally picked shea nuts. Now that the sale of these nuts is profitable, men are becoming involved in this activity, often with the assistance of their wives (Zuidberg 1994).

The adoption of technology may also shift the gender division of labor. For example, in Tanzania, one study finds that men are becoming more involved in agriculture as use of the plow becomes more widespread and as maize, especially hybrid maize, is grown (Holmboe-Ottesen and Wandel 1991). Similarly, the adoption of maize technologies in Zambia has affected gender labor patterns (Celis and Holleman 1991). In households that adopt new technologies, men work more on crops and animals and less on nonfarm tasks, while women spend less time on crops and more time on post-harvest activities. Children shift from tending crops to tending animals. The adoption of technology increases the use of both household and hired labor in all months.

Many studies seem to suggest that as technologies and the social and economic environment change, the burden on women increases (Kranz and Fiege 1983; Berio 1984; Suda 1996). Even with good intentions, many of the projects designed to decrease women's workloads may not produce the intended effects. The introduction of maize mills is one such example. In Burkina Faso, one study finds that as small commercial corn mills became available, the time women spent hand-milling grain did not decrease. Instead, they purchased commercially-milled grain to supplement hand-milled grain only on occasions when they otherwise would have gone without the meal (McSweeney 1979). On the other hand, in Gambia, cereal mills may positively impact women's welfare by reducing their workloads, saving both time and, more importantly, their energy (Barrett and Browne 1994). The introduction of mills, however, may have little effect if women do not have the cash to use them (Freudenberger 1994). Similarly, programs that require women's labor inputs may not succeed if the benefits do not accrue to the women themselves. There is some question about how changes in the division of labor affect the well-being of individual household members. As women's labor burdens and responsibilities increase, their control over their labor and

output may also increase. Stamp notes that among the Kikuyu, as the division of labor by gender becomes more relaxed, men feel less responsibility toward their wives, but the wives gain greater independence (Stamp 1976). With the increased availability of mills in Burkina Faso noted above, the net effect on women's well-being from preparing and eating an additional meal is unclear. With many of these changes, it is difficult to say whether men or women gain or lose. Increased labor input may be accompanied by increased independence and control over the output. A comparison of two villages in Ethiopia with similar ethnic composition, but different economic activities, finds that the sexual division of labor is a less important indicator of well-being than the ability to earn an income (Olmstead 1975).

Gender is not the only criterion for classifying labor allocations. In many instances, the age and status of the individuals within a household may also affect their responsibilities. A case study of the Dagomba in northern Ghana identifies five categories of social standing for women: retired cooking wives, active cooking wives, junior wives, unmarried women, and divorced women. Women in these different categories have different roles, opportunities, and responsibilities (Warner et al. 1997). Similarly, in Kenya, young Luo women defer much of the decision-making about their farms to their mothers-in-law (Potash 1981). They do not obtain the rights to farm independently until some years after they have married and had children. Few studies have looked at the differentiation of individuals by age and status when analyzing agricultural production and technology adoption. The effects of new technology may also vary by religion or ethnicity. For example, the benefits of an irrigation scheme in Nigeria differed depending on the ethnic or religious group of the participating women. The project benefited Muslim women, who are involved less in agriculture and more in trading, producing, and selling snack foods. The non-Muslim women did not benefit, because their labor was increasingly demanded on the men's fields and they had less time to work on their own plots (Jackson 1985).

The gender division of labor appears to change in response to changing economic opportunities. The extent to which these changes benefit or disadvantage women and men is not always clear, and it is difficult to predict *a priori* what changes will occur. The fact that adopting new technology may cause a reallocation of labor across tasks and alter the balance between household and outside labor suggests that it may be difficult to compare households that have adopted technology with those that have not. Instead, it is important to consider the characteristics of adopting households before they adopted the technology. Understanding intrahousehold dynamics in a specific context provides some insights into this issue. These concerns are discussed later in this paper.

Seasonality of labor

The seasonality of tasks is especially important in Africa,[3] and it interacts with the gender division of labor to provide additional constraints. Labor bottlenecks are common during the planting and harvesting seasons. Households with access to large amounts of household labor or the ability to mobilize nonfamily labor will have an advantage during those times.

Much of the research on the seasonality of labor does not look at labor by gender; a notable exception is Kumar's (1991) study in Zambia. She examines gender patterns of seasonal labor allocation for Zambia, comparing households that adopt hybrid maize with those that do not. She found that although the average number of hours of female labor spent in cropping activities is higher for females than males in both adopting and nonadopting households, the seasonal labor patterns for cropping are similar for men and women (although, in adopting households, the peak for women's labor in June is steeper than that for men).

Problems passed by the seasonality of labor demand may be exacerbated by the gender division of labor. To the extent that male and female labor are not substitutes, the household faces seasonal constraints for each. In a study in Burkina Faso that examines all household and agricultural

[3] Seasonal demands for labor are more pronounced in Africa than in Asia. In Africa, 50-70% of the labor is required within a four-month period. Comparable figures for Asia are 40-50% (Delgado and Ranade 1987).

activities, the gender division of tasks appears to be complementary. The peaks in the workloads of men differ from those of women (Zuidberg 1994), suggesting that there may be some opportunities for men and women to assist each other during peak workloads. However, the fact that the peaks are defined separately also suggests that cooperation does not smooth the peaks significantly. Seasonal patterns for one group may affect the other's patterns. In Cameroon, the men's economy has a clear peak in labor requirements during the cocoa harvest. However, women also increase their income-generating activities during this period to take advantage of the additional cash in the local economy (Guyer 1980). Thus, it is important to consider the relationships between the seasonality of labor among men and women and between agricultural and nonagricultural activities.

Household Labor Availability

A farmer's access to labor, especially during the peak demand for labor, will affect his or her choices of activities and technologies. Household members provide one important source of labor. This section addresses factors affecting the availability of household labor; the availability and use of hired labor are discussed in the following section.

Although many empirical studies on agricultural production and technology adoption use household size and composition as important explanatory variables,[4] these factors are clearly endogenous to agricultural production. Household size and composition are affected by the demand for agricultural labor. Similarly, the structure of households is both a response to agricultural opportunities and a factor that affects the agricultural opportunities of individuals in the household (McMillan 1987).

Migration

Household size and composition are critically affected by migration. Throughout Africa, women are *de facto* heads of households because the men have migrated to earn higher wages elsewhere. Migration, especially of healthy adult men, results in fewer men being available in rural areas for agricultural work. Many studies cite the shortage of male labor within the household as a constraint on agricultural productivity (Rukuni and Eicher 1994). It is important to note, however, that men are most likely to migrate when the expected returns from migrating are higher than their productivity on the farm. In Malawi, the incidence of female-headed households varies inversely with the economic potential of the rural area (Chipande 1987). Thus, in theory, increasing cash crop agriculture (or agricultural potential in general) in an area may actually increase the labor supply available for maize and cereal production by encouraging men to remain in the area (Goetz 1993). However, little empirical evidence exists to substantiate or refute this claim.

Although often the outmigration of men results in lower agricultural productivity due to shortages of male labor within the household, remittances from those men may potentially negate this constraint. Remittances may give a household the opportunity to hire labor and, in some circumstances, may provide much needed capital to increase the use of inputs (Pala 1983). Off-farm income is frequently used to finance farming in Malawi (Smale 1991) and Zimbabwe (Rohrbach 1989). The extent to which remittances are sent and to which they are available for investing in agriculture, rather than in housing or children's education,[5] will influence the effects of migration on agricultural productivity. Francis and Hoddinott (1993) find that in Kenya, migrants are reluctant to invest in agriculture. Instead, they prefer to invest in urban real estate, small businesses, and education. Migrants grow less willing to invest in agriculture as their time away from the farm increases.

Female-headed households

Whether or not a household is headed by a woman is often an important factor in agricultural productivity and the adoption of technology. It is important, however, to note

[4] Arene (1992) finds that household size is not significant when regressed on output. Kumar (1991) finds that the number of adult equivalents has a positive effect on total household labor allocated to farming. Family size, however, is not significant in predicting maize adoption or the area under hybrid maize that is conditional on adoption. In Rwanda, Randolph (1988) finds that the presence of both a wife and daughter in a farm household is associated with a 58% increase in the area cultivated, a 42% increase in the value of the harvest, and a 34% increase in the value of marketed crops.

[5] Rorbach (1989) notes that in Zimbabwe, school fees compete with agricultural inputs as a use for cash resources.

how a household is classified as female-headed.[6] Frequently, households are defined as female-headed only if there is no adult male present. Since male-headed households almost always include at least one adult female, the distinction between male- and female-headed households is both an issue of the gender of the household head and of household composition. The latter may be more important. In addition, *de facto* female heads are included in some studies as female-headed households and not included in others, consequently, results may not be comparable across studies. Finally, comparing female- and male-headed households provides only limited information about broader gender concerns because it ignores the majority of women who live and farm in male-headed households.

Although there is great heterogeneity among female-headed households (Peters 1995), on average they tend to be smaller than male-headed households, have lower incomes, and are typically less likely to adopt new technologies (Due and White 1986). It is difficult, however, to disentangle the cause and effect relationships among these factors. Almost by definition, female-headed households are smaller than male-headed households, simply because any household that contains both adult men and women is considered male-headed. To the extent that female-headed households are smaller than male-headed households and household size is an important determinant of productivity, we may expect to find that female-headed households are less productive than male-headed households (Larson and Kanyangwa 1990). Reverse causality may also apply: a household may be female-headed because the farm had low productivity and the male head left to find better paying work. Thus, the low agricultural income-potential of the household may contribute to the household becoming female-headed. The correlation can also arise when women have less access to credit and other inputs, in which case a woman head of the household lowers the household's agricultural income potential. There is also a correlation between household income and technology adoption. Although adopting new technology may increase household income, some threshold of income and information may need to be achieved before a farmer is willing to innovate and adopt new technologies.

Thus, we would not necessarily expect empirical studies to present a clear relationship between female headship and the adoption of technology. Although in some cases there may be a negative relationship between adoption of technology and female headship, the finding that female headship is not significant in explaining fertilizer adoption in Zambia (Jha and Hojati 1993) should not be surprising. Examining the gender of the head of household only captures one component of the many gender-linked barriers to technology adoption.

Health considerations

A final set of factors that affect the amount of available household labor is the health of household members. Illness of household members limits their ability to do agricultural work and also may require other household members, usually women or girls, to care for the ill. For both men and women, it may be important to consider the seasonal impacts of health as a production constraint. The rainy season, which is the busy time for planting and weeding, may also be the time when illness is most likely (Eicher and Baker 1982). The high expenditure of energy during this period may also result in energy deficiency and weight loss (Bleiberg et al. 1979).

The number of healthy individuals in a household is endogenous. In addition to decisions about fertility and household composition, decisions about how to allocate nutrition and health care are made within the household.

Finally, women face the additional burden of pregnancy, which may limit their ability to perform heavy farm labor. It is frequently noted that women prefer farm tasks that are compatible with watching small children, but many tasks may be quite difficult in the later stages of pregnancy. Baksh et al. (1994) finds that pregnant and lactating women contribute significantly less income-generating labor over two years than other women. Women in households with the lowest standard of living, while pregnant and lactating, devote less time to labor-intensive

[6] See Rogers (1995) and Peters (1995) for a detailed analysis of the problems with the concept of female headship.

activities, such as farming. This may be because women from poorer households are less well nourished and are trying to conserve energy. Thus, decreased labor availability due to pregnancy and lactation may put additional stress on small and poor households. For all households, the age and childbearing status of women will affect the household labor available for agriculture.

Allocation of household labor

Technology adoption may affect the use of household labor. Again, it is important to note that these relationships are dynamic and it is difficult to predict *a priori* how adoption of technology will affect the use of household labor. Although new technology is often viewed as labor saving, it is important to determine whose labor is saved and at what point during the agricultural season. Celis and Holleman (1991) examine the relationship between technology adoption and household labor use in eastern Zambia. Of particular relevance, they note that households that use the highest level of technology employ more family labor than households that use the lowest levels, even after accounting for family size. In this case, adoption of technology increases rather than decreases the use of family labor.

It is important to recognize how the allocation of household labor within agriculture affects other activities. Ikpi (1992) identifies three sectors of household economic activity: agriculture, the non-farming commercial sector, and household production activities. He emphasizes that the allocation of household labor among these three sectors will be affected by the adoption of technology and exogenous factors such as prices. Changes in one sector, such as the introduction of new technology, will affect the allocation of labor across all three sectors.

One important factor that affects an individual's willingness to provide labor within the household is how the proceeds are divided among household members. This issue is discussed in the section on household decision-making.

Agricultural Labor Markets

Farmers' access to off-farm labor, especially during critical periods, may affect both the adoption of technology and the levels of production. Hired labor may be paid in cash or in-kind. In addition, numerous communities have labor sharing arrangements, through which people work together on each others' farms.

It is not clear from the literature under what circumstances farmers prefer to hire labor and when they prefer to use cooperative or shared labor arrangements. It appears to depend upon the traditions within the community and the extent to which the cash economy has penetrated the region. For example, Davison (1992) finds that women in southern Malawi prefer to hire labor rather than depend on cooperative efforts, even when the cooperative efforts involve female relatives. She attributes this to the historical value of autonomy in the community. In some regions of northern Ghana, the use of nonfamily labor may be greater than 30% of total labor input; nonfamily labor typically performs the most tedious tasks and those most easily supervised, including soil tillage, weeding, and harvesting. Thus, farmers spend relatively large amounts, in cash or in-kind, hiring laborers (Runge-Metzger and Diehl 1993).

Women may face additional costs when male labor is hired, regardless of whether the household is male- or female-headed, if meals must be provided for the laborers (Lassiter 1981; Zuidberg 1994). In addition, the quality of hired labor may be lower than that of family labor (Fortmann 1980), and outside labor requires supervision and monitoring. This can be costly. Of course, the labor provided by some household members may also be of poor quality and unreliable, and families may have less flexibility in handling unproductive family labor.

In some regions, households may prefer to engage in cooperative labor arrangements rather than hire labor outright. In Burkina Faso in the early 1980s, 10% of labor was supplied by "*invitations de culture*," under which a farmer who was behind in weeding organizes a work party and provides food and drink to those who attend (Lassiter 1981). Similarly, Ongaro (1990) found that in western Kenya the use of hired labor is rare; instead households share labor during peak seasons. In Zimbabwe, few farmers appeared to hire labor, primarily due to the expense (Rohrbach 1989).

The use of labor from outside the household varies from little or none to fairly high levels, but the pattern is not necessarily a move away from cooperative labor arrangements to hired labor. Goheen (1988) observed a considerable increase in labor exchange among Nso women in Cameroon since Kaberry (1968) wrote about this group 38 years earlier. Although she notes that cooperative groups are essential for breaking labor bottlenecks, clearly work groups attend to some fields in a more timely fashion than others. It is not clear whose fields are completed in a timely fashion and whose fields are left until last. The timing of the work parties will affect the productivity of the plot.

Labor markets for male and female wage labor may be highly segmented by gender (Koopman 1991; Donhauser et al. 1994) with female agricultural wage labor generally remunerated at much lower rates than male labor. In Kenya, women typically hire men for traditional "men's tasks" and women for traditional "women's tasks" (Pala 1983). The extent to which women work for wage labor also varies considerably across areas. In northern Ghana, much of the wage labor is done by women, and this provides them with an important source of cash income (Runge-Metzger and Diehl 1993). In other areas, women's domestic responsibilities limit their ability to participate in wage labor.

The outmigration of men is only one way in which the labor markets in other sectors of the economy affect the labor available for agriculture. Opportunities for men and women to earn nonfarm income vary tremendously between regions. Wage labor in nonagricultural sectors is relatively rare in many rural areas, but off-farm activities, such as agricultural processing and trading, frequently supplement household income. Okeyo (1979) claims that 90% of Luo women farmers in Kenya engage in informal economic sector activities. In a survey paper examining studies from across Africa, Reardon (1997) finds that nonfarm income provides 22–93% of total rural incomes. Relatively little work has been done on the relationship between agricultural productivity and off-farm opportunities, especially by gender.

It is critical to understand how agricultural production fits into the broader rural economy in order to determine the most appropriate ways to increase agricultural productivity and the welfare of poor producers and consumers. The most effective way to improve the well-being of members of rural households may not always be through increasing agricultural productivity.

Conclusions: Labor and Gender

The labor available to a farmer depends on the amount of household labor that is available (and which can be mobilized) for agriculture and by the availability of nonfamily labor. Female-headed households may have a harder time gaining access to labor because they have less male labor within the household and they may have less resources for hiring nonfamily labor. It is unclear how well women farmers in male-headed households are able to mobilize household, hired, or cooperative labor for agriculture given that the labor of both men and women may be required. Increasing opportunities for men and women, both within the agricultural sector and in other sectors of the economy, will affect the allocation of labor within the household.

Access to labor may affect the adoption of technology and the distribution of its benefits. The literature provides information on numerous dimensions along which gender may be important, and it suggests a number of questions that should be considered to further understanding about how differential access to labor by gender may affect technology choices. A number of cautions were cited earlier in this paper about the uses of these data, nonetheless, the following questions remain important: What is the division of labor, both by crop and by task? How have these changed over time, especially in response to changing economic opportunities? In particular, who tends to be the primary grower of maize? To what extent is maize grown for home consumption or for sale? Does this vary according to whether modern varieties (MVs) or traditional varieties are grown? Who provides the labor for different tasks? Is there a rigid breakdown by gender? What other activities are household members involved in? How do seasonality, migration, and labor markets (both agricultural and nonagricultural) affect the availability of

male and female labor for agricultural activities? The preceding discussion provides insights into why these questions are important and how they can help researchers determine whether access to labor will be a constraint to the adoption of maize technologies.

In addition, although many of the static studies of gender and labor allocation give us useful insights, it is important to understand how labor patterns are renegotiated when economic opportunities change. The gender divisions of labor by crop and by task do not remain constant as new opportunities arise. The effect of these changes on the welfare of individual household members, especially women and children, will depend on a number of institutional factors.

Land

Decisions about technology adoption are affected by access to land and the security of land tenure. Individuals with insecure tenure will generally be less likely to invest in new technologies that require complementary immobile inputs. An individual's land tenure depends on formal legal structures at the national level, mechanisms at the local or village level, and rules for allocating land among household members.

Land tenure arrangements vary considerably across Africa. In some areas, women have traditionally held land and maintained rights over it. In other areas, men retain the rights to land, but provide women with access to it through marriage. In discussing women's access to land, it is important to note the extent to which women have formal and customary rights over the land that are independent of their husbands. It is sometimes argued that women's access to land is generally not a problem where social institutions allocate land to both men and women or where women can borrow or claim unused land (Bryson 1981). This suggests that it does not matter how an individual obtains access to land or how access to land changes with varying economic conditions. However, both women's access to land and the security of women's land tenure will affect decisions regarding the adoption of technology.

Access to Land

There are a number of means through which people in Africa have access to land: they may own it outright, they may have land allocated specifically to them through their lineage or village head, or they may acquire land through marriage. To date, the literature on land tenure and adoption has focused on the relationships between landlord and tenant, not between male and female members of a lineage or household.

Formal land markets, in which titled land is bought and sold or rented for cash, are relatively rare in Africa, though in southwestern Uganda, for example, active rental markets for land are reported (Grisley and Mwesignwa 1994). Formal land markets generally require that the land be titled or registered through government agencies. Legal structures that restrict women's ownership of land—either officially or unofficially—will affect their access to land.

In northwestern Zambia, Hansen reports that farmers buy and sell the rights to use cleared land. The land itself cannot be sold, but the rights to use cleared land can be. One initially acquires the rights to use land by clearing it (Hansen 1994). It is not apparent whether this pattern would affect men and women differently, except that women usually require male labor to clear land.

Land may be allocated through traditional means, e.g., the lineage or village head allocates land to individuals. In part, these allocations will be based on the head's perception of different individuals' need for land. To the extent that women are perceived as needing or being capable of farming less land than men, we can expect their allocations to be smaller.

Finally, women may obtain access to land through a male relative, however, that access may also entail limitations on the uses of the land. Among the Beti of southern Cameroon, women cannot inherit land. They are granted food plots by their husbands, but they cannot plant cash crops on them (Koopman Henn 1983). In Hausaland in Nigeria, trees are individually owned, but the owner of the trees is not necessarily the owner of the land on which the trees grow (Jackson 1985). An

abundant literature reports that regardless of how access to land is gained, women tend to have smaller landholdings than men. In addition, women's landholdings may be less fertile and more distant from the homestead (Barnes 1983; Jackson 1985; Keller et al. 1990; Alwang and Siegel 1994).

Security of Land

The long-term security of land tenure will often affect the adoption of technology. To the extent that a new technology involves long-term investments or is complementary with other long-term investments, farmers may be reluctant to adopt the technology if they lack secure tenure. In making investment decisions, farmers are concerned with their future benefits. The expected future benefits shrink if there is a high probability that a farmer will lose the land where the investment has been made. Generally, the poorest farmers and those with the most insecure tenure are less likely to adopt new technologies (Kershaw 1976). Similarly, a woman who obtains land through marriage may hesitate to invest in it when she perceives her marriage as precarious (Kranz and Fiege 1983).

Furthermore, access to land does not ensure tenure over it. In many instances, the lineage maintains control over the land. The differential effects on men and women, however, will vary. In Zambia, most land belongs to the lineage. In both matrilineal and patrilineal societies of the Eastern Province, women only have access to land through male relatives. When a marriage dissolves, the land reverts to the lineage and the woman has only limited claim on any land (Milimo 1991). Among the Haya of Tanzania, women farm grassland plots, but do not have permanent rights to the land (Koopman Henn 1983). Similarly, of 176 women farmers in Kenya interviewed by Davison (1988) in 1983–84, only one woman, a widow, held land registered in her own name.

There are situations in Africa, however, where women have secure tenure to the land. Hirschmann and Vaughan (1984) suggest that in Malawi, women possess family matrilineal land, and land rights are retained by women, even upon the death or divorce of their spouse. Eighty percent of the women surveyed claimed that the land they farmed was theirs and that they would not lose it upon a divorce. Similarly, among the Luo in Kenya, women acquire land through marriage, but they are able to keep the land and bequeath it (Potash 1981).

One important reason why farmers want secure rights of tenure or formal ownership of the land is to enable them to obtain credit. In Zambia, the lack of formal titles to land has been considered an impediment to smallholders' access to credit. This problem is usually more severe for women.

Although we might venture that women are better off when they have the rights to land, other factors may undercut this advantage. For example, in matrilineal areas of Kenya, a man generally will not want to contribute labor to land that belongs to his wife and that will remain in her lineage (Davison 1987). Women, however, frequently contribute their labor to land owned and controlled by men.

Changing Access to Land

Access to land is not static, nor is tenure over land. As circumstances change, farmers' access and secure tenure to landmay also change. These circumstances may include legal revisions, such as the formal registering of land, or economic changes, such as increased agricultural productivity or population pressure on the land. Many such changes have been occurring in Africa.

Formal land titling programs may affect women's access to land. Although, in theory, many places will register land in either women's or men's names, in practice, most of the land is registered in the names of men. For example, among the Joluo of Kenya, 97% of the women reported in 1983 that their land was already registered; however, 91% of the land was registered in the names of men, who have exclusive rights to allocate or sell it (Pala 1983). Land allocated by the Kenyan government has been inequitably distributed between men and women, while land allocation by villages has been more equitable (Saito 1994).

In a detailed analysis of the historical processes of land registration in Kenya, Davison (1988) notes that land was

usually registered in the names of male elders. When an elder died, no effort was made to transfer the title to his widow; however, she could reasonably expect to be allowed to continue cultivating the land. With the introduction of land sales, women have had to worry about their secure tenure to such land as conflicts now arise over ownership. Stamp (1976), however, argues that laws allowing women to own land have engendered more respect for women from men. Formal registration of land appears to be a mixed blessing for women generally, and certainly some groups of women will benefit more than others.

Women tend to have better access to land when it is abundant. As population pressures increase, women's access to land may become more difficult.[7] In Burkina Faso, it is reported that if there is enough land and water, women do not seem to have a problem obtaining access to land. The family head allocates personal plots to women and young men, but the head retains some authority over the plots and can reclaim them (Zuidberg 1994). Hirschmann and Vaughan (1983) note that although women in Zomba, Malawi, have traditionally had access to land, regardless of their marital status, increasing land shortages are now limiting their access. The women claim that they do not now have rights to enough land to guarantee economic independence. In Mali, as land becomes less available, women are becoming workers on family fields, rather than farmers in their own right (World Bank 1995).

More profitable land use opportunities may also reduce women's access to land. For example, in Zimbabwe, the introduction of cash crops has resulted in a reduction in the amount of land a woman is granted for planting her crops (Muchena 1994). Similar effects have occurred among the Nso in Cameroon (Goheen 1988) and the Bushi in Zaire (Schoepf and Schoepf 1988). With increased land productivity provided by new technologies or new crops, men may place more emphasis on agriculture and require that more of the land be under their control. In particular, Potash (1981) expresses concern that as land becomes scarcer and agricultural development programs focus on increasing men's involvement in agriculture, women's access to land will be threatened. Based on a historical analysis of Malawi, Vaughn (1985) argues that the point in time when women enter commodity production is important. If they enter it at the same time as men, they may have more bargaining power to retain their land once land becomes scarce.

Thus, we can identify many factors that will affect women's access to land. To understand how access to land will affect technology use and agricultural productivity in a particular region, we would want to explore some of the following questions: Are there formal markets for the sale and rental of land? Are there limitations on women owning or leasing land? Is land allocated through traditional means? If so, what formal and informal rules are used to allocate land? What rights accompany different forms of access to land? Does the land available to men and women differ in its inherent qualities and distance to the village? How secure are the different forms of land tenure for men and women? Is land scarce? What are the alternative uses for the land?

The implications for technology development in response to gender issues in access to land and tenure are not clear. Many of these issues must be resolved at a higher policy level. However, developing technologies that require more secure land tenure, e.g., those requiring significant investments in the soil on a particular plot, will disadvantage those with insecure tenure—in many instances, these will be women. An additional consideration is that increasing the economic returns on plots of land may result in farmers with insecure tenure losing access to those plots.

Access to Other Inputs

In Africa, new technologies are needed to significantly increase maize production. These technologies are usually based on the use of agricultural inputs, especially fertilizer, seed, and extension services or other sources of information. Credit, in turn, is often needed to finance some of these inputs. Numerous studies, referred to below, indicate that women have less access than men to these inputs. To understand these access issues, it is important to consider whether constraints to access are based specifically

[7] For evidence on Botswana, see Fortmann (1980).

on gender or on other factors that may be highly correlated with gender, such as size of landholdings. In this section, I will briefly discuss how gender may interact with each specific input and the broader gender issues surrounding access to inputs.

Access to Credit

Credit is often a prerequisite for the adoption of improved seeds, especially hybrids, and fertilizer. Although farmers may use income from off-farm activities to purchase these inputs, they still may require credit at certain times of the year. Credit may be tied to the purchase of a particular input, such as seeds or fertilizer, or it may be in the form of general agricultural loans. Numerous government programs for providing credit have been tried in Africa, but most have proven unsuccessful and have been discontinued. The challenge for credit programs is to provide credit that is appropriate for the client farmers and sustainable over the long term.

As mentioned earlier, a farmer's ability to obtain credit may be correlated with access or tenure to land. In places where some land is titled, it may be difficult for a farmer whose land is not titled to obtain credit, a common circumstance for many smallholders. But access to credit may not be based solely on legal rights. Credit may be tied to the lender's perception of the farmers' ability to repay the loan. Thus, large-scale farmers who produce a surplus for sale may have better access to credit than small-scale farmers, regardless of their tenure status. In Zimbabwe, the extension of credit to smallholders is cited as one reason for the successful expansion of smallholder maize production. However, to receive credit, farmers had to document their ability to produce a marketable surplus, usually by showing receipts from past sales. The farmers who subsequently obtained credit were from high-rainfall zones and had above-average farm resources (Rohrbach 1989). To the extent that women are perceived as producing more for home consumption and less for the market, they may have a harder time obtaining credit when this criteria is employed.

Another factor that may affect access to credit is a farmers' affiliation with an agricultural organization. Credit may be provided through a variety of sources, notably cooperatives, farmer's associations, and input suppliers. If women are excluded from these organizations, either officially or *de facto*, and access to credit is tied to membership, women may be disadvantaged simply because of their gender. Moreover, these organizations often provide more than credit; they also frequently provide extension information. Through their exclusion, women may be doubly disadvantaged.

Where women have less access to credit, informal savings organizations may provide an alternative route to mobilizing funds for agricultural inputs, e.g., rotating savings and credit programs (ROSCAs). These funds, however, are not necessarily used for agricultural inputs. Savings clubs may be another means of obtaining capital to purchase agricultural inputs. In Zimbabwe, most savings club members are women. These clubs do not have funds to lend, but they provide a means for women to mobilize savings. In Lesotho, women—especially the poorest women—frequently form self-help groups, but these informal groups are not officially recognized and thus they cannot provide their members with access to credit or official government assistance. Instead, women are encouraged to join formal mixed-gender organizations, but they often lack the land that is a prerequisite for participation in those groups (Safilios-Rothschild 1985).

Credit programs designed for women and individuals without access to collateral have been tried in other parts of the world; the Grameen Bank in Bangladesh is an oft-cited example. The Grameen Bank makes use of women's social capital by using a group lending approach. Groups of five women are granted credit, but no group member is eligible for additional credit if any fellow member is in arrears. Farmers' clubs in Malawi also attempt to use relationships among individuals as a form of collateral. However, farmers who are perceived as being the highest risk by other farmers are not included in the clubs (Chipande 1987; Jones et al. 1996). Hence, these types of credit programs may not reach the poorest segment of the population. The extent and impact of gender bias in these programs is unclear.

To summarize: women's access to credit may be limited by the perception that they produce crops for subsistence and not for the market, by their less secure land tenure, and by the provision of credit through organizations that are geared toward men.

Access to Fertilizer

Farmers' fertilizer use depends on two things: (1) whether fertilizer is available in their area in a timely fashion and (2) whether the farmer has the resources to purchase fertilizer. The impact of fertilizer use on productivity also depends on whether farmers apply it appropriately on their fields.

Supply problems have been widely cited to explain why farmers do not purchase and use fertilizer. Imports are often regulated and frequently there are bottlenecks in distribution that are attributable to poor infrastructure (e.g., see Kumar [1991] on Zambia and Blackie [1994] on Zimbabwe). When supplies are limited, there must be some basis for allocating fertilizer. For instance, when prices are controlled by the government, some form of rationing must occur. Generally, farmers with the most influence on the suppliers will obtain the fertilizer. Under these circumstances, women are less likely to obtain fertilizer. Market-oriented approaches use price to allocate fertilizer, to the advantage of farmers with access to cash or credit.[8] Hence, women, who commonly have less access than men to cash and credit, will again generally have a harder time purchasing fertilizer. The increase in fertilizer prices that occurs when subsidies are removed may further disadvantage those without access to credit. Gladwin (1992) emphasizes the importance of fertilizer subsidies as a means of increasing maize production among women farmers and increasing household food security. Using examples from Cameroon and Malawi, she argues that structural adjustment programs that remove fertilizer subsidies affect female farmers more than male farmers, because they reduce the use of fertilizer on local maize, which is a woman's crop.[9]

A second concern with fertilizer use is its effectiveness. The impact of fertilizer use on productivity depends on how appropriate the application procedure is for the specific area. Kumar (1991) notes that the increased use of fertilizer in eastern Zambia in the early 1990s had limited impact on yields due to poor application. This highlights several potential problems. One is that farmers may not be aware of the recommended application procedures (this will be covered in greater detail in the following discussion of farmers' access to extension services). In addition, the recommendations may not be appropriate for a given farmer's fields. The absence of appropriate fertilizer recommendations is noted as one reason for the limited use of inorganic fertilizer by communal farmers in Zimbabwe (Blackie 1994). Page and Chonyera (1994) note that farmers who purchase inputs from local stores in Zimbabwe don't necessarily follow the product instructions, whereas communal farmers who receive credit to purchase fertilizer are required to use the recommended rates. However, Page and Chonyera (1994) suggest that the recommended rates are too high and too expensive to make fertilizer use profitable for farmers.

It should also be recognized that fertilizer may not be applied efficiently across all of a household's plots. Smale (1991) suggests that in Malawi, many farmers who fertilize their local maize do not do so on all of their plots. This would only be efficient if there were differential costs to application or if farmers applied fertilizer based on soil types. These factors, in turn, would only have a gender effect if the costs of application differed for men and women or if the soil types varied between men's and women's plots. Another explanation for fertilizing some household plots and not others would be that farmers, who may only able to obtain or afford a given quantity of fertilizer, try to maintain recommended application levels on some of their plots, even though higher returns would be obtained from allocating the fertilizer across all plots. Similarly, in Burkina Faso, Udry (1996) finds that fertilizer is not efficiently allocated across plots, even those plots planted to the same crop. He attributes this to the control of plots by different individuals within the household.

[8] Rorbach (1989) notes that for Zimbabwe, access to credit may be more important than the price of fertilizer.

[9] Smale and Heisey (1994) argue that while Gladwin's contention may be correct, her analysis does not support her claim that female farmers are more disadvantaged by the removal of the fertilizer subsidy than male farmers.

As with credit, the determinants of fertilizer use are highly correlated with gender. Farmers with more land and more access to cash or credit are more likely to use fertilizer.

Access to Extension and Information

The usefulness of extension and related information services rests on both the farmer's access to the source of the information and its quality and appropriateness. Access to appropriate information may have a significant impact on agricultural productivity. In Tanzania, Fortmann (1976) noted that knowledge of maize recommendations correlated with recommended maize practices. Similarly in Kenya, the availability of extension services has a significant effect on output, producing increases of 7.5–18.8 % (Ongaro 1990). In 1976, however, Moock (1976) examined farmer efficiency in Kenya and found that the use of extension services resulted in higher yields for men but not for women. It may be that women received different qualitative or quantitative levels of extension services or that information provided by extension was more appropriate for the conditions under which men were farming.

There is evidence that in many instances women farmers are not reached by extension services (Baser 1988; Saito and Weidemann 1990). For example, a study in Malawi in the early 1980s found that few women ever had contact with extension agents and that women's participation in agricultural training was limited (Hirschmann and Vaughan 1984). The contact farmer system, in which an innovative group of farmers who have adopted new ideas and technologies teach other farmers, tends to exclude women (Baser 1988). In Zambia, few women farmers were chosen as contact farmers, and female household heads were less likely than men to know the name of their contact farmer or extension agent (Due et al. 1991).

Female-headed households may be especially disadvantaged. Saito (1994) notes that female-headed households are not served well by extension agents, who often prefer to talk to women in male-headed households rather than those in female-headed households. Thus, a bias might not simply be based on gender, but also on status and household structure. However, it is not clear that the bias would necessarily favor women in male-headed households.

In looking at extension services and information access, it is difficult to disentangle the effects of gender and income levels. In Zambia, extension reaches only 25% of farmers, and it fails to reach the poorest farmers (Alwang and Siegel 1994). To the extent that these are women, extension is not reaching female farmers. Hirschmann and Vaughan (1983) observe that the bias of extension was against poor households, not against women in particular. They found that those farmers who had enough land to grow maize in pure stands (as recommended) had adequate labor and capital, and use inputs were the most likely to receive assistance from extension agents (Hirschmann and Vaughan 1984). Because women are underrepresented in this group, they are less likely to obtain assistance.

Some efforts to reach women through extension services have been successful. In Zimbabwe, emphasis has been placed on having extension work with groups, and indeed, women there constitute the majority membership in such groups (Muchena 1994). These groups provide extension services and also make it easier for the women to gain access to credit. Yet, women's participation is still constrained by a variety of practices, including the expectation that a woman's husband must approve any legal transaction in which she is involved.

Sources of information outside of extension may also be important. According to Tanzanian farmers in the 1970s, those sources, in descending order of importance, were private agricultural supply companies, mass media agricultural information, an instruction book, and extension service demonstration plots and interactions (Fortmann 1976). In Zambia, even contact farmers did not think that extension agents provided them with their most useful information (Due et al. 1991). Thus, it may be important to consider access to information in a much broader context than just access to extension services.

No gender-based analyses of access to information from agricultural supply companies have been conducted.

Cooperatives are another source of information, but women are frequently excluded from them (Baser 1988). The extent to which these and other farmer organizations focus on male or female farmers will influence gender bias in access to information.

Finally, utilization of information may depend on education and literacy levels. Lack of education and higher levels of illiteracy among women farmers may be an additional constraint to women receiving adequate information (Fortmann 1976; Baser 1988).

Access to Mechanization

Although there are studies on mechanization in Africa (Pingali et al. 1987; Grenoble 1990; Seifert 1993), little emphasis in the literature has been placed on the differential access of women and men to mechanization. In many areas, smallholder farmers still rely on hand-held hoes and cutlasses for most farm work, hence mechanization is not an important issue. In other areas, animal traction is used for plowing. In these areas, access to draft animals affects a farmer's output. Women tend to own fewer oxen because they are a relatively large capital investment. Given the labor constraints of many female-headed households, Fortmann (1980) suggests that it may be preferable to hire oxen for plowing than to purchase them and then hire labor year-round to maintain them. Plowing with animals is still usually considered men's work, and although women do use plows, most often women farmers hire men to plow their fields. Hiring animals or workers to plow results in less control over scheduling the plowing activities.

Gender Issues in Access to Inputs: Summary

There are several sets of gender issues that bear on access to inputs. The first issue is whether there are constraints based solely on gender that limit access, e.g., formal laws and regulations that prohibit a married woman's access to credit without her husband's signature. Even if formal rules do not prohibit women from obtaining credit, often informal norms of organizations that provide credit may prevent women from independently obtaining it. Membership in cooperatives and farmer organizations that control access to inputs may be based on gender, either officially or in practice. Continuing perceptions that women are not "real" farmers, but only helpers on family farms, may also limit their access to resources (Safilios-Rothschild 1985).

In addition, many of the factors affecting access to inputs are strongly correlated with gender. Access to inputs may depend on the size of landholdings, level of income, or potential level of agricultural production; women may be disadvantaged in all of these, thus it becomes difficult to disentangle the cause and effect relationships. Finally, household survey data usually investigates the use of inputs, rather than the farmer's access to them. Consequently, they do not always tell us whether the lack of access to these inputs is a binding constraint for farmers. There are also questions as to whether women and men, given the same levels of access to resources, would choose to use the same inputs; however, there is strong evidence that both men and women make rational decisions. It may be particularly important to compare the access to inputs of women farmers in male-headed households and female-headed households. Programs or groups that restrict membership to household heads, such as credit associations and export crop marketing cooperatives in Malawi, may disadvantage married women more than female household heads (Koopman Henn 1983). Similarly, the Lima bank in Zambia reportedly required a husband's permission before a married woman could apply for a loan; single women, meanwhile, had to prove that they were unmarried (Keller et al. 1990). It is not clear how such policies affect the access to credit of female household heads.

Simply comparing male- and female-headed households may not provide adequate information on access to inputs. We need a broader framework that considers more types of households to understand fully which farmers have access to resources and which do not. This type of analysis may also provide information as to whether the constraints are based on gender, household structure, or on the size and scale of the farm.

It is a challenge to determine the extent to which differential use of inputs by men and women results from the different constraints they face. To disentangle these issues, it is important to ask the following questions: How is credit obtained? What collateral is required? Do men and women have equal access to the collateral? Are there specific constraints that limit women's access to these inputs because of their gender, such as legal restrictions on women's access to credit based on marital status? Is access to specific inputs dependent upon other characteristics of farms or farmers that may be correlated with gender, such as the size, and productivity of the farm? Does the quality of inputs, such as extension, differ for men and women? Answers to these questions will help us to sort out whether the constraints to increased input use are directly related to gender *per se* or to other factors correlated with gender.

Outputs

Given access to inputs, the choice of which ones to use and in what quantities will be affected by the objective function of the individual farmer. Farmers may try to maximize profits, maximize returns to labor, or maximize household food security. Given markets that are not perfect, farmers will usually choose to produce for both household consumption and market sales. As discussed earlier, men and women may emphasize different traits in their production choices for either home or market. When growing crops that will be sold immediately post-harvest, the primary concern will be yield;, but when growing crops for home consumption, storage, processing, and taste considerations may also be important. Thus, to the extent that gender influences the end use of the crop, men and women may have different preferences regarding varietal traits.

Many researchers have argued that women would benefit from improved storage qualities in maize. However, relatively little information on preferences regarding storage exists in the literature. Existing storage technologies may not be well-suited to high-yielding varieties. A model McHugh (1993) develops suggests that the adoption of improved seeds is inadvisable because of quantitative and qualitative losses incurred during storage. It is not clear whether it would be more efficient to develop varieties that store better using existing techniques or to develop new storage technologies.

Processing characteristics will affect varietal selection. Women are almost universally charged with the processing of maize; thus they may be especially concerned about processing characteristics. People in both Zambia (Jha et al. 1991) and Malawi (Hirschmann and Vaughan 1984) report that the dent hybrids are more difficult to pound. Kumar (1991) notes that the new varieties are often not compatible with existing processing methods. The extent to which new processing technologies could result in the acceptance of these varieties is unclear. Processing includes pounding, milling, and in some areas, fermentation. In Ghana, Tripp (1993) notes that the new varieties require longer soaking periods for fermentation, which particularly affects small-scale food processors and sellers.

Smale (1995) has done extensive work in Malawi on farmer preferences in maize characteristics. Smallholders produce maize for home consumption and market sales; thus they are concerned about both yield and texture. The traditional local varieties of maize have a flinty texture, which means they have higher flour-to-grain extraction rates and they store better under traditional methods, while most of the introduced hybrids have been dents that produce higher yields in the field. When storage and processing concerns are considered, however, the flint varieties ultimately display higher yields for household consumption. The development of semi-flint hybrids in Malawi is resolving some of these constraints.

The new varieties may taste different (Bukh 1979; Hirschmann and Vaughan 1984), but in Africa, taste *per se* is rarely noted as a reason for choosing one variety over another. Some issues regarding taste may be considered as processing concerns.

The introduction of mills may influence the selection of varieties and may also affect time allocation within the household. Because processing maize by hand is time-intensive, we might expect that mills would be widely accepted, however, women's time is not highly valued and

mechanical mills may not make economic sense. In Mali, one study examines the potential determinants of demand for maize flour products. It finds that working women appreciate the convenience of maize flour; however, the poverty of many urban households limits the effective demand for purchased maize flour (Boughton et al. 1997). Similarly, in Kenya, the quantity purchased of sifted maize meal rises with increasing household income. We might expect that it particularly rises with the increased incomes or time value of women. Households cite price and convenience as major determinants of the quantity of sifted maize meal that they purchase (Mukumbu and Jayne 1995).

A number of factors may affect the types of preferred outputs. As the value of women's time increases, particularly in urban areas, women frequently choose foods that are less time consuming to prepare. This may involve the substitution of milled varieties of maize for hand-pounded maize or the substitution of one crop over another. In Mali, urban households shift to rice from maize and other coarse grains as the value of women's time increases (Dibley et al. 1994). Although the cost of a meal of coarse grains is lower, processing costs, measured in time, are a larger component of the total cost of this type of meal. Examining countries in both East and West Africa, Kennedy and Reardon (1994) find that the value of women's time is a more important determinant of consumption decisions than the total household income.

Relatively little work has been conducted on gender differences with regard to desired outputs. To analyze possible impacts, a number of questions could be considered: What is the use of the crop? Is it for home consumption, sales, or both? What are the desired characteristics in terms of storage, processing, and taste? This data would need to be considered together with information on household decision-making to determine which combination of characteristics would be chosen.

Household Decision-Making

Numerous studies note that men and women in Africa frequently engage in different production activities and that in many cases they are not jointly managed. This suggests that it is important to treat individual production activities separately, while also examining the relationships between them. In addition, men and women may be involved in separate consumption activities, often described as men and women having separate purses (Guyer 1980).

In the economics literature, however, the tendency has been to assume that although the activities were separate, it was still possible to treat the household as a single economic unit, making a single set of production and consumption decisions. Recently, a growing literature in economics has challenged the traditional models, emphasizing the importance of understanding the dynamics within the household. This work claims that outcomes depend on the dynamics and distribution of resources and power within the household.

Agricultural household models, which explicitly incorporate both production and consumption decisions (Singh et al. 1986), provide one set of reasons that undergird the importance of considering gender constraints in agricultural production. To the extent that women have limited access to resources based on gender, female-headed households will be disadvantaged relative to households that include men. As men move out of agriculture, these models suggest that it may be important to consider reducing the constraints to increased productivity by women.

However, recent household decision-making models and the empirical evidence supporting them suggest that there are more important reasons for examining the gender-based constraints facing farmers. These models more accurately reflect the reality of African households, although specifics vary widely across Africa. Two categories of models can be considered: cooperative bargaining and collective models, and noncooperative bargaining models.[10]

[10] For a detailed description of the different models and the empirical distinctions between them, see Doss (1996).

Cooperative Bargaining and Collective Models

In cooperative bargaining models or collective models of the household, individual household members are assumed to have different preferences, but resources are pooled and individuals bargain over how to allocate them. The outcomes of decisions made within the household will be affected by the bargaining power of individual household members. Any factor that affects an individual's utility outside of the household will affect his or her bargaining power within the household, including individual income, access to land and other resources, kinship networks, and other legal and social structures.[11] Evidence from numerous locations supports this model. In particular, numerous studies suggest that women's access to land and other resources from sources outside of the household affects their access to resources within the household (Siandwazi et al. 1991). In Ghana, the distribution of asset ownership within the household affects health and education outcomes (Doss 1997). In Cameroon, Koopman (1991) finds that the terms on which women farmers gain access to credit, labor, or land not owned by their husbands, affects their bargaining power regarding decisions about household resources. The amount of land that women receive from their kin may affect the levels of independence enjoyed by different wives of the same husband (Bryson 1981). The exchange of labor and resources within the household is finely balanced. Staudt (1987) notes that when the "terms of trade" become too unfavorable to women, they may choose to leave their husbands.

There is substantial evidence that men and women choose to spend the money under their control differently (Hoddinott 1993; Zuidberg 1994; Doss 1997).[12] Household expenditures are often a matter of negotiation and conflict. In Zambia, Geisler (1992) reports that wives often try to insist that the crop should be bartered for clothing and other household items. In addition, conflicts may arise regarding how much of the produce to sell, especially if women are more concerned with retaining adequate food supplies while men are more interested in obtaining cash to purchase other goods (Holmboe-Ottesen and Wandel 1991). Thus, policies or technologies that affect which person earns and controls income may affect the outcomes of household decisions.

In terms of agricultural productivity, these models suggest that if men and women have different preferences regarding labor allocation, agricultural production, or consumption, the bargaining power of individuals will affect the outcomes of decisions. In particular, men and women may have different preferences over which crops to produce and the levels of inputs to use. Therefore, when comparing households that have the same household structure and level of endowments, we might find different outcomes if the allocation of endowments among household members differs.

Noncooperative Bargaining Models

The second category of models, often referred to as noncooperative bargaining models, suggests that resources within the household are not pooled. In these models, individuals within the household make separate decisions. Individuals retain control over their own resources, including labor, and independently make allocation decisions. Obviously, these decisions are conditioned on the relationships within the household, in particular the "conjugal contract" or the expectations about the contributions that men and women will make to the household. For example, men may have the ability to requisition women's labor for some activities without compensation, whereas for other activities, women must be compensated. The conjugal contract determines the terms of trade among household members.

One result that is consistent with these models is that outcomes may not be Pareto efficient. In other words, changes in the allocation of resources could result in a situation in which at least one household member is made better off, without making anyone else in the household

[11] There has been an effort within the literature to show that exogenous measures of bargaining power affect household decision-making. Many of the measures of bargaining power that are discussed here, including incomes, access to land and other resources, and kinship ties are endogenous to the household, especially when marriage markets and household formation are treated as endogenous.

[12] These examples are all from Africa, however, similar evidence is available from other areas of the world. Some examples are cited in Doss (1996).

worse off. In Africa, several such cases have been documented. Udry (1996) finds that in Burkina Faso, by shifting inputs from plots controlled by men to plots planted to the same crops controlled by women, the total level of production increased. In Cameroon, Jones (1983) found that labor was not allocated efficiently across men's rice fields and women's sorghum fields. If the household could be treated as a single economic actor, then we would not expect to see these inefficient allocations. The explanation that is frequently given for this is that women are not willing to provide additional labor if they do not receive compensation. Thus, projects that require additional female labor but provide the remuneration to the male household head may fail.

Such inefficiencies should not occur if people within households can trade freely with one another. In the Burkina Faso case, we might ask why men don't "sell" inputs to their wives for part of the increased profit that would result. The economic models do not seem to resolve this question: Why isn't there full trade within the household? The case studies from Africa suggest that individuals are not just concerned about maximizing profits or output in the short run, but that they are also concerned about maintaining their control over resources in the long run. Trades within the household might increase productivity in the short run but change the balance of resources in the long run. The intrahousehold models have important implications for empirical analyses of technology adoption and impacts. They insist that it is important not to simply assume that the household is the appropriate unit of analysis. Questions should be addressed to the farmer; however, the status of the farmer within the household will affect the constraints faced by that particular individual. Constraints may differ among household members. For example, women may have less ability to mobilize household labor, but this ability may vary between women depending on their status as wife (and, within polygamous households, depending on her status as junior or senior wife), mother, daughter, or in-law of the household head. Since household resources may not be pooled, the farmer may not have access to all of the household income and wealth. Thus, measures of income and wealth of both the farmer and the household should be included in analyses.

One way that some studies have tried to incorporate intrahousehold dynamics is by asking which household member makes the decisions about different aspects of agricultural production. This information is particularly important in studies of technology adoption. Yet, household decision-making may also respond to economic changes. For example, Abbott (1976) finds that in Kenya, the relative decision-making power of the wife increases significantly when the husband is a migrant. However, the relationships are more complex than this simplification might suggest. Some women who are coresident with their husbands have high levels of decision-making power, e.g., older women whose in-laws are no longer living and women who earn substantial income through entrepreneurial activities. Meanwhile, some women whose husbands are absent have low levels of decision-making power. They live on extended homesteads, have been married a relatively short time, or have husbands who earn relatively high incomes. It is difficult to disentangle the cause and effect relationships. For example, entrepreneurial ability and household decision-making skills may be related. Women with high levels of decision-making power within the household may use their independence to start their own businesses. In addition, the ability to earn a cash income may increase her power over decisions within the household. Yet, the correlation tells us something about how different groups of women may respond to changes in their economic environment.

Differences in the decision-making power of women may also be based on age and status within the household (Safilios-Rothschild 1985; Zuidberg 1994). Among the Luo, a recently married woman will farm under the close supervision of her mother-in-law for many years. Thus, older women are able to influence agricultural decisions much more than younger women (Potash 1981). In northern Ghana, Warner (1997) identifies five measures of social status within the household for women. Women in these different classifications have different levels of decision-making power, including the allocation of their own labor. Marital status, however, was not found to be significantly useful in predicting men's activities (Warner and Warner1996).

Government policies may affect the household decision-making structure. For example, in Zimbabwe, the decision to allow women to sell produce directly to the Grain Marketing Board, without the involvement of their husbands, has given them more control over their produce (Muchena 1994). And, as previously suggested, policies affecting the land tenure patterns of women may affect the outcomes of household decisions.

The introduction of new technology may change the balance of power within a household. For example, in Gambia, rice was a woman's individual crop. The introduction of centralized pump irrigation, which was designed to benefit women, resulted in rice becoming a community crop under the authority of the male compound head (von Braun and Webb 1989). The introduction of a mechanical maize sheller into a Nigerian village shifted the control of the shelling process from men to women (Ladipo 1991). The men responded negatively, arguing about the price and demanding free shelling; eventually, some of them seized the machine. Thus, shifting the balance of power can have unforeseen repercussions that may affect both productivity and welfare.

Changes in technology that increase the use of inputs that require cash or credit may affect household decision-making. Greater dependence on cash may increase a women's dependence on remittances from her husband (Hirschmann and Vaughan 1984). In addition, women may not be able to avail themselves of new technologies that require cash from men, if the men do not realize a direct benefit (Saito 1994).

Finally, to understand intrahousehold dynamics, it is important to have a working definition of the "household." The application of this term is problematic in many parts of Africa. Typically, households are defined as a group of people living under one roof, eating out of the same pot, and making some joint decisions. However, in Africa, production and consumption units may not be the same. In areas where child fostering is common, household composition may also depend on whether children are fostered out or in.

For studies of agricultural productivity, we would want to know the status of the farmers within the household—how are they related to the household head? In addition, we would want to know something about the size and structure of the household. Is it extended vertically, with several generations engaged in agricultural production? Is it extended horizontally, with people such as the head's siblings present? What is the ratio of children to adults? How many people in the household cannot contribute to household production? Are some household members away for part of the year? Do they send remittances and are they involved in household decision-making? Is the household polygamous? The requisite information about household size and structure will depend on the questions being addressed, however, the emphasis on collecting data on individual farmers should not exclude the collection of basic information about the household structure.

Thus, to understand decisions about agricultural production, we need to know which individuals are making the decisions and what specific constraints they face. Although the identity of the decision maker and the associated constraints may change with new economic circumstances, past research on intrahousehold dynamics, especially that from Africa, assures us that it is important to be attentive to these issues.

Conclusions

The story that emerges from the literature on women and agricultural production in Africa is enormously complex. The African farm household is a diversified and multi-faceted economic entity. It pursues numerous agricultural and nonagricultural enterprises and operates within elaborate networks of credit, insurance, and contracts. The households include people with competing goals and objectives, cooperating fully on some issues and less so on others.

It is clear from the literature that "gender matters." The literature documents many changes that have occurred in gender roles and responsibilities as a result of new economic opportunities, which may result from changes in agricultural technology or urbanization and economic growth. The gender patterns change, and in some cases,

the gender divisions of labor become less rigid—but gender remains an important analytic category. No future changes are likely to make gender less important in our understanding of technology adoption and agricultural productivity.

Claiming that gender is an important analytical category, however, does not tell us what should be done *a priori*. The literature documents many examples of projects and interventions that were designed to benefit women. These efforts failed many instances, in part, because they did not recognize the complexity of women's roles and responsibilities within households and communities. Even when projects took into account women's initial roles and responsibilities, they failed to anticipate the dynamic impacts of their interventions. In some cases, better research could have revealed potential problems before they arose. In other cases, however, it is unlikely that anyone could have predicted *ex ante* the full impact of the projects in terms of the reallocations of rights and responsibilities among individuals.

An additional problem with targeting research toward women is that it is unclear what exactly is meant by the notion of "technology benefiting women." Ideally, improved maize technologies would increase agricultural productivity, including that of women farmers; increase the availability and affordability of maize for consumers, especially poor women; and promote economic growth, thereby expanding nonagricultural opportunities for women.

New technologies, however, often have both positive and negative effects. Increasing the productivity of land may encourage men to return to agriculture and decrease women's access to land. New agricultural technologies that increase output may also increase women's labor input. This, in turn, may add to women's labor burdens, but simultaneously increase their control over the output. *Ex ante*, we may not be able to determine which effects will be the strongest, and *ex post*, it may be difficult to untangle the net effects.

In spite of the complexity of the issues, the International Center for the Improvement of Wheat and Maize (CIMMYT) and others in the agricultural research community can draw some important lessons from the literature. First, better baseline surveys of households and communities are needed *before* new technology is introduced. To build our knowledge base of dynamic effects of technology adoption, it is critical to have studies that examine patterns of labor allocation, land allocation, and individual household member welfare—both before and after the introduction of new technology. Comparing adopting and nonadopting households does not provide us with this information. We can only understand the relationships *ex post*, given the appropriate data collection and analysis.

Where baseline surveys have been done, care must be taken in interpreting the findings. For example, the discovery that farmers who use improved maize varieties have larger plots of land than nonadopters does not necessarily imply that farmers with larger landholdings are *more likely* to adopt improved varieties. We cannot conclude this without information on the size of farmers' landholdings at the time the adoption decision was made. Qualitative research, however, may provide insights into how to interpret the quantitative results. For example, we should be more comfortable drawing causal relationships about land size and technology from *ex post* surveys if we know that the patterns of landholdings have not changed over the relevant period.

Second, it seems clear that agricultural researchers need to continue to listen to both male and female farmers. These farmers may have insights into how the adoption of a technology may affect the relationships among household members. Often, it may be useful to interview nonfarming members of households too and ask them how they might expect their activities to change with the introduction of new technologies.

Third, there are a few specific technological issues that have relatively direct effects on women's well-being. Women in Africa tend to be responsible for processing and preparing food, including maize. They provide most of the

labor for these activities, although they may not control all of the processes. Innovations that increase the productivity of women's labor in these areas may benefit women, however, the benefits will depend on what activities will replace the hours formerly spent processing and cooking food. Improved storage characteristics may also improve women's well-being, although again the dynamic effects of such changes are not clear.

This analysis suggests that many of the early pronouncements about what we should do to benefit women farmers were overly naive. The past 25 years of research have succeeded in identifying many of the factors that are now, and will continue to be, important for women, such as access to land, credit, fertilizer, and extension services. The literature also demonstrates that it is important to consider women farmers individually, but at the same time, it is increasingly clear that we need to understand the decisions and constraints they face in the context of their households and communities. The simple dichotomies of men's crops and women's crops, cash crops and food crops, or male- and female-headed households do not provide sufficient insight. Gender relationships change, and we do not always thoroughly understand how they will respond to the introduction of new technologies. Acknowledging this provides both substantial challenges for social science research on gender issues in the future and exciting opportunities to understand these complex relationships.

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Gender Issues and the Adoption of Maize Technology in Africa: An Annotated Bibliography

Cheryl R. Doss and Amy McDonald

Introduction

As new technologies for maize production become available in Africa, a number of gender issues arise. To what extent do women farmers adopt these technologies? How do the constraints faced by women farmers affect their decisions about technology adoption? How does the adoption of technology affect women farmers and how does it change the dynamics of labor and resource allocation within the household?

Unfortunately, few of these questions have been directly addressed with regard to maize technologies in Africa. However, the following annotated bibliography includes a wide range of articles that provide some insights into these issues, including articles on women and farming in Africa, technology adoption, maize farming in Africa, and household decision-making.

In instances where the majority of articles in an edited volume are relevant, the book, rather than the individual articles, is cited in the bibliography. In instances where only one or two articles are relevant, the specific articles are cited.

Abbott, S. 1976. Full-time farmers and week-end wives: An analysis of altering conjugal roles. *Journal of Marriage and the Family*. Pp. 165–73.

Decision-making patterns among the Kikuyu of Nigeria (where maize is the staple crop) are analyzed with special attention focused on the contrast between cultural expectations and verbal reports of actual decision patterns. Reports about decision-making processes suggest that women possess more decision-making power, either individually or jointly with their husbands, than expressed under the cultural ideal. Factors including labor migration (and the subsequent absence of the husband), homestead structure, phase in the domestic cycle, control of valuable resources, and the employment status of the wife all have the power to override traditional expectations. This article concludes that women's real decision-making power may extend beyond what is often indicated in surveys or interviews, which may reflect cultural ideals more than actual patterns of behavior. Understanding how decisions are made and who makes them are essential for the planning of research and development projects.

Adams, A. 1993. Food insecurity in Mali: Exploring the role of the moral economy. *IDS Bulletin* 24(4): 41–51.

Understanding local systems of mutual insurance is important to designing strategies for famine prevention and development efforts. In Mali, the center of Bambara social and economic organization is the household. A household is composed of individuals who negotiate between collective and individual interests in the process of farming common fields and consuming grain from a common granary. Through exchange and social investment, households attempt to spread their risk. Within the village, households spread risk through their relation to lineage households, nonlineage households, artisans, and age-set groups. Beyond the village, households maintain relationships with migrant workers, in-laws, and local traders. In the early stages of widespread food crises, nonmarket transfers are very common and vital. If a crisis continues for a sufficient length of time, however, households limit aid to immediate family members and the ability of nonmarket transfers to cushion food insecurity diminishes. Those excluded from nonmarket transfers tend to be households with insufficient production that are marginalized from exchange networks because they are unwilling or unable to invest in social strategies and institutions that mediate nonmarket exchange. Women and men play different roles in managing risk. Women maintain close social ties with their natal families and villages, while men's links are with age-based groups and lineage ties.

Adekayne, T.O. 1987. African women in agriculture: Problems and policies for development. *Presence Africaine* 141: 7–14.

This paper is a general discussion on the need to integrate women into development projects. It makes specific reference to Nigeria, where women are important in agriculture, especially in food production, processing, and distribution. Regional differences among women in the west, north, and east regions of Nigeria are discussed. Women in the north have much lower participation in farming than in the west or east, predominately because of traditional Muslim beliefs. The author cites women's relatively low participation in cooperative groups as evidence that women are marginalized in development programs and argues that poor farmers, both men and women, should be targeted as recipients of development aid. Maize is a subsistence crop often grown by women. This article offers a general explanation of the need to incorporate women into development schemes and suggests possible areas for policy intervention.

Adesina, A.A., and M.M. Zinnah. 1993. Technology characteristics, farmers' perceptions and adoption decisions: A Tobit model application in Sierra Leone. *Agricultural Economics* 9: 297–311.

This paper tests whether farmers' perceptions of the characteristics of improved varieties of mangrove swamp rice affect the adoption decision. The authors examine the impact of farmers' perceptions of taste, yield, ease of cooking, tilling capacity, and ease of threshing on the adoption and intensity of adoption. Farmers' perceptions of these characteristics are significant in explaining their decisions, whereas the farm– and farmer–specific characteristics are not. The gender of the farmer is not included.

Adesina, A.A., and K.K. Djato. 1997. Relative efficiency of women as farm managers: Profit function analysis in Côte d'Ivoire." *Agricultural Economics* 16: 47–53.

Using a profit function approach, rather than the standard production function approach, the authors compare the efficiency of men and women rice farmers in Côte d'Ivoire. The results suggest that the relative degree of efficiency of women is similar to that of men. The study concludes that it is necessary to eliminate the bias against women rice farmers.

Alwang, J., and P.B. Siegel. 1994. *Rural Poverty in Zambia: An Analysis of Causes and Policy Recommendations.* Washington, D.C.: Human Resources Division, Southern Africa Department, The World Bank.

This volume in a five-volume series on poverty assessment in Zambia focuses on rural poverty. Since maize in Zambia is the staple crop, policies regarding maize production and pricing have a significant impact on the poor in rural Zambia. Comparisons are made of male- and female-headed households in poverty. The issues of access to land and land tenure are critical for understanding rural poverty, and women frequently have less access to productive land. A household model is developed that shows how farmers optimize their farming systems to deal with a number of constraints.

Appleton, H. 1995. *Do It Herself: Women and Technical Innovation.* London: Intermediate Technology Publications.

This volume contains a series of case studies of successful technical innovations by women in Africa, Latin America, and Asia. The only agricultural project cited is one to increase the production of indigenous vegetables in Kenya, although a number of food processing projects are presented. The introduction to the volume provides insights from the case studies into when women will be involved in technical innovations—these lessons may be applicable to a wide range of activities, including agricultural production.

Arene, C.J. 1992. Comparative economics of maize and rice production among resource-poor farmers in Anambra state of Nigeria. *African Development Review* 4(1): 102–13.

Maize and rice are staple crops of Nigeria. While Nigeria has the resources to be self-sufficient in both crops, current production is insufficient to provide enough food for the growing population. This paper seeks to determine how output can be raised. It examines the characteristics of poor smallholder farmers in Anambra State of Nigeria who are already using improved seeds, fertilizers, and crop husbandry techniques recommended by extension agents. The regression analysis shows that farm size, credit, level of adoption of recommended production technologies, level of formal education of farmers, and age of farmers are significantly related to the maize farmers' output. Household size and number of years of farming experience are less important. While the results of gross margin analysis reveal a greater profit margin for rice than for maize, the author does not recommend a reallocation of resources from maize to rice because of soil type and environmental considerations. No mention of gender is made, and the sex of the household head was not included in the regression analysis.

Asenso-Okyere, W.K., G. Benneh, and W. Tims (eds.). 1997. *Sustainable Food Security in West Africa.* Boston: Kluwer Academic Publishers.

This publication discusses many of the key issues related to sustainable food security in West Africa. Contributions cover subjects of food availability, accessibility, and utilization. Most of the articles are on Ghana, although an article on the maize market in Benin is also included as are two articles on Burkina Faso. The book came out of a policy

dialog begun in 1992; the articles are designed to be relevant to policymakers in the region.

Baksh, M., C.G. Neumann, M. Paolisso, R.M. Trostle, and A. A. Jansen. 1994. The influence of reproductive status on rural Kenyan women's time use. *Social Science Medicine* 39(3): 345–54.

This paper examines the effects of pregnancy and lactation on Embu women's productive and reproductive work. Time allocation data were gathered from 169 households using the spot observation technique from March 1985 through February 1986. This data provides empirical information on the changes in women's commercial, agricultural, and household activities during pregnancy and lactation. The results indicate that the demands of pregnancy and lactation cause women to devote less time to subsistence agriculture, commercial activities, housework, and livestock husbandry. Agricultural and economic activities are particularly limited during the last trimester of pregnancy and the first three months of lactation. The decrease of time spent on subsistence agriculture, commercial activities, and household work can have significant welfare effects on poor smallholder households. Maize is the staple crop of the region, and because the Embu have two agricultural growing seasons per year, the six months of limited agricultural activity will fall during at least one season of peak activity. The decreased labor input of women at this time might have significant effects on maize production, especially in households where women provide much of the labor.

Barnes, C. 1983. Differentiation by sex among small-scale farming households in Kenya. *Rural Africana* 15/16: 41–63.

In this paper, the existing gender-based division of adult labor of Kenya is analyzed and put in a historical perspective. The number of female-headed households is increasing, in part due to men migrating to supplement farm income with urban employment. Three types of households are discussed: those headed by married men, those headed by married women, and those headed by single women. Households headed by men are typically larger and better off than married or single-women headed households. Single-women headed households are typically the poorest category. The well-being of a married woman who heads a household may depend on remittances provided by her husband. Despite these variations, no significant difference was found between the output per acre or in input utilization of female- and male-headed households. On women-headed farms especially, the division of labor for productive work has largely dissolved. The social construction of gender concerning reproductive work, however, has not changed; women continue to be viewed as responsible for household and reproductive work.

Barrett, H.R., and A.W. Browne. 1994. Women's time, labour-saving devices and rural development in Africa. *Community Development Journal* 29(3): 203–14.

Effective approaches to rural development in Africa require saving women's time. Using the Gambia as an example, this article discusses the effects of the introduction of village cereal mills on women. The paper focuses on women's access to milling technology, the technology's welfare effects, and its sustainability. The research shows that cereal mills positively impact women's welfare by reducing their workloads. The energy saved by milling contributes more to this workload alleviation than does the time gained. Unfortunately, due to underutilization and high maintenance costs, cereal mills are unsustainable.

Baser, H. 1988. *Technology, Women, and Farming Systems*. Ottawa, Canada: Agriculture Canada.

This study evaluates three widely used extension systems (contact farmer system, T & V, and RDP) and their dissemination of technology to African smallholders. The author claims that under each of these systems, women have less access to technology than do men. Technology may have an impact on production, consumption, and organization that will be affected by gender. A strong division of labor underlies a "conjugal contract" that values men's work more than that of women and gives men more control over household resources and productive technology. The power relations within the household refute the assumption that what is good for the "household" will be equally good for all of its members, particularly women. The social and political status of women is examined and is linked to women's ability to access technology. This article provides a useful discussion of women's access to technology and extension services and intrahousehold differences in decision-making power.

Baumann, H. 1928. The division of work according to sex in African hoe culture. *Journal of the International Institute of African Languages and Cultures* 1(3): 289–319.

This classic paper, written in 1928, discusses women farmers in Africa. It distinguishes hoe cultures, in which women dominate agriculture and matrilineal systems are prevalent, from plow cultures, in which women and men work in conjunction and patrilineal systems predominate. The author says that in West Africa, maize is a woman's crop, while in the plow cultures of East Africa, maize is a man's crop. This paper is interesting for its historical significance; it set the stage for many later discussions of gender in African agriculture.

Berio, A.-J. 1984. The analysis of time allocation and activity patterns in nutrition and rural development planning. *Food and Nutrition Bulletin* 6(1): 53–68.

This paper uses time allocation data from the Central Africa Republic, Nepal, and Côte d'Ivoire to explore how activity patterns may be affected by development projects. In the Central Africa Republic, time allocation data for two villages

are compared. Work loads in both villages are heavier for women than men and work loads in the modern village are significantly higher than the traditional village. The Côte d'Ivoire survey again notes that females have heavier work loads than males, even when compared within age groups. They find that women provided 54% of the calories brought into the kitchen in addition to performing their demanding domestic tasks. Agricultural activities constitute a major share of energy expenditure. In addition, time devoted to agricultural work adds to women's tasks instead of replacing them and is the major differentiating factor among the various levels of physical activity.

Bindlish, V., and R.E. Evenson. 1997. The impact of T&V extension in Africa: The experience of Kenya and Burkina Faso. *World Bank Research Observer* 12(2): 183–201.

Evidence from Kenya and Burkina Faso suggests that T&V extension systems support agricultural growth and produce high returns on investments. Higher yields are achieved in areas served by extension, and within those areas, by farmers who participate directly in extension activities. Thus, extension helps to bring the potential gains from existing technologies to farmers. However, additional research will be needed to develop relevant technologies. The T&V system appears to be reaching both male- and female-headed households, although there were few women farmers in the Burkina Faso sample.

Birkhaeuser, D., and R.E. Evenson. 1991. The economic impact of agricultural extension: A review. *Economic Development and Cultural Change* 39(3): 607–50.

This review article examines the empirical studies of the impact of extension and discusses the methodological problems that they share. In particular, most of the existing studies ignore the possibility of endogeneity in observed extension/farmer interactions and the prevalence of information flows among farmers. The majority of studies reviewed indicate a significant positive impact of extension, but the methodological shortcomings of the studies leave many questions yet unanswered. Specific issues regarding which farmers benefit from extension, including differences by gender, are not addressed in the article.

Blackie, M.J. 1990. Maize, food self-sufficiency and policy in East and Southern Africa. *Food Policy.* Pp. 383–94.

During the past century, maize has become a staple food in eastern and southern Africa. Maize is an important cash crop and provides opportunities for agricultural labor within the region. However, annual average yields have remained low, especially considering the rapid rate of population growth. This paper examines government policies that have influenced maize producers in eastern and southern Africa. The objectives of economic policies, such as price policy and government intervention in maize marketing, have included improving national maize self-sufficiency and stabilizing maize prices for consumers. Despite these policies, many countries still face erratic maize supplies. The effects of these policies are examined by contrasting the experiences of different countries within the region. Available maize technology is not being fully utilized, in part because maize research has been biased towards large-scale producers and high-cost production methods. Many smallholder households face food insecurity and cannot meet their annual household food requirements. It is noted that female-headed households often face labor shortages and must compensate for absent males by hiring labor or purchasing yield-increasing inputs. No account is given, however, of how the government policies discussed have specifically affected women.

Bleiberg, F.M., T.A. Brun, S. Goihman, and E. Gouba. 1979. Duration of activities and energy expenditure of female farmers in dry and rainy seasons in Upper Volta. *The Nutrition Society* 43(71): 71–82.

The energy intake and expenditures of fifteen female farmers (aged 18–47 years) from Burkina Faso were estimated and assessed during the dry and rainy seasons. Energy expenditures for various activities were measured by indirect calorimetry. During the dry season, daily energy output of female farmers is classified as between moderately and very active and in the rainy season as exceptionally active. The very high level of energy expenditure during the rainy season, attributable to the compulsion to spend long hours at heavy work, may lead to energy deficiencies and explain rainy season weight loss.

Bleiberg, F., T.A. Brun, S. Goihman, and D. Lippmann. 1980. Food intake and energy expenditure of male and female farmers from Upper-Volta. *British Journal of Nutrition* 43(71): 71–82.

The food intake and energy expenditure of 11 male and 14 female adult farmers were measured for 6 days after the harvest in December and January. This was a time of relative food abundance and included two market days. Body-weight as a percentage of the expected weight-for-height was 91% for women and 86% for men. Carbohydrates accounted for 80% of total energy intake with fat and protein supplying 13% and 12%, respectively. In the male group, the mean energy intake corresponded closely with the average energy output. In the female group, however, the mean energy expenditure exceeded the mean energy intake. The magnitude of the energy deficit found for female farmers suggests either incomplete measurements of food consumption or an overestimation of energy expenditure. Comparisons to women of similar energy intake in other developing countries are conflicting and point to the need for further investigation. Although sorghum and millet are the staple crops, this study points to the need to compare food intake and energy expenditure in order to gain greater insights into the nutritional needs of African farmers.

Boserup, E. 1970. *Women's Role in Economic Development.* New York: St. Martin's Press.

This is the classic work on women's role in economic development, including agriculture, which initiated much of the discussion of this topic in the 1970s. Boserup identifies two patterns of subsistence agriculture, based on whether the men or the women are the primary food producers. She claims that men do little farm work in areas that are sparsely populated and where shifting cultivation is used. Where extensive plow cultivation is used, women are involved in agriculture, but men are the primary food producers. However, men and women both work on the farm in areas where irrigated land is intensively cultivated. Based on these generalizations, most of Africa consists of patterns of female farming. Since much of the work on women's roles in agriculture has been in response to Boserup's claims, this book provides a useful base for understanding the discussions and research that have taken place in the past three decades.

Boughton, D., T. Senghore, and G. Langan. 1985. A study of farmers' intercropping practices and objectives and the performance of maize/cereal patterns in the Upper River Division, 1985. Washington, D.C.: USAID.

This study recorded and evaluated the farming practices in the Upper River Division. Various types of maize intercropping patterns are discussed, along with four other crop-based patterns. Farmers intercrop maize for greater yield stability (i.e., an insurance policy against low returns to labor and land, especially in areas with low soil fertility or where assurance of obtaining fertilizer is low) and other benefits (i.e., using the same amount of land for more than one crop.) The authors conclude that intercropping is better than using fertilizer to stabilize yields of maize, sorghum-maize, and millet crops when environmental conditions are poor. The authors suggest that certain improvements, such as improved plant varieties, better intercropped plant ratios, and allocation and timing of fertilizer applications could make groundnut and maize intercropping systems perform better. More focus should be given to finding better ways of intercropping cowpea with maize or cotton.

Boughton, D., T. Reardon, and J. Wooldridge. 1997. Determinants of Diversification of Urban Sahel Diets into Maize: A Contingent Valuation Study of Processed Maize Demand in Mali. Paper presented at the International Association of Agricultural Economists, Sacramento, California.

Using contingent valuation techniques, this paper explores the potential demand for new maize flour products in Bamako, Mali. Working women particularly appreciate the convenience characteristics of maize flour. The demand for this convenience food increases with the ability to afford the flour and the increased opportunity cost of time. Yet, due to the poverty of many urban households, new maize products still have only a moderate effect on the overall demand for maize.

Bryson, J.C. 1981. Women and agriculture in sub-Saharan Africa: Implications for development (an exploratory study). In N. Nelson (ed.), *African Women in the Development Process.* Totowa, New Jersey: F. Cass Publishers. Pp. 29–46.

This paper examines the important role women play in food production in sub-Saharan Africa. The social structures that support the division of labor in agriculture are closely examined and the effects of economic change in the twentieth century are discussed. The author claims that analysis based on the unit of the household is inadequate. Different members of the household wield different amounts of bargaining power. Factors that influence women's decision-making power within the household include varied access to land, number of wives present, and independent income. Finally, the paper discusses how women's role in agriculture affects the agriculture industry and the development process.

Bukh, J. 1979. *The Village Woman in Ghana.* Uppsala, Sweden: Scandinavian Institute of African Studies.

Based on a survey of Ewe households in Ghana in 1973, this book provides a detailed picture of women's roles in agricultural households and discusses how colonialism impacted women's roles and women's access to resources. Changes in society created new opportunities for women to make decisions, but also burdened women with new demands on their time and less support. In particular, the introduction of cocoa and migration of men from the area greatly impacted women's situations. At the time of the survey, hybrid maize was not being grown by women because it was seen as a cash crop and women preferred to grow crops that could be consumed by the household.

Burfisher, M.E., and N.R. Horenstein. 1993. *Sex roles in the Nigerian Tiv farm household and the differential impacts of development projects.* Case Studies of the Impact of Large-Scale Development Projects on Women 2. New York: Population Council.

This detailed case study provides information on how an agricultural development project may affect the intrahousehold allocation of tasks and resources. New technological packages were introduced to increase farm productivity. Among the Tiv, there is a clear division of control of crops by gender and a strong gender division of labor by task. The crop which increased most in value as a result of the project was yam, which along with maize, is a traditional women' s crop. The authors note that this may result in men taking over yam farming, similar to what they did with rice farming in the 1950s. Women's access to land and household decision-making are also examined in this paper.

Burton, M., and D. White. 1984. Sexual division of labour in agriculture. *American Anthropologist* 86(4): 568–83.

This paper reviews many of the anthropological explanations for why there is a sexual division of labor in agriculture. The authors claim that the number of dry months and the importance of domesticated animals to subsistence are the most important predictors of women's contribution to agriculture. The use of the plow and crop type are also important. Population density has only weak effects.

Byerlee, D., and P.W. Heisey. 1996. Past and potential impacts of maize research in sub-Saharan Africa: A critical assessment. *Food Policy* 21(3): 255–77.

This review of maize research over the past 20 years and the adoption patterns of improved maize technology concludes that many countries have had considerable success. However, there is room for additional gains to be made, especially in the areas of maintaining soil fertility and increasing labor productivity. Raising agricultural productivity depends on policy, institutional, and infrastructural development. Many of the issues raised are of concern to women farmers in Africa, although gender issues are not addressed specifically. In particular, the post-harvest characteristics of improved varieties and the seasonality of labor are issues affecting women farmers.

Byerlee, D., and C.K. Eicher (eds.). 1997. *Africa's Emerging Maize Revolution.* Boulder, Colorado: Lynne Reinner Publishers.

This edited volume provides case studies of maize adoption in Africa and a series of chapters focusing on the lessons that can be learned in the areas of research priorities, soil fertility and fertilizer use, the maize seed industry, and marketing and pricing policy. The editors emphasize that the lessons for achieving food security in Africa and the prescriptions for a green revolution cannot be obtained by looking at the Asian Green Revolution experience, but instead must be drawn from case studies in Africa. This book provides a framework through which to examine these lessons.

Campbell, C.C. 1991. Food insecurity: A nutritional outcome or a predictor variable. *Journal of Nutrition* 121: 408–15.

Food security is the access for all people at all times to enough food for an active, healthy life. At a minimum this includes a readily available supply of safe and nutritionally adequate foods and the assurance that personally acceptable foods can be procured in a socially acceptable way. Risk factors for food insecurity include factors that limit household resources such as money, information, time, or health factors that constrain the proportion of resources available for food acquisition. This paper discusses measures of food insecurity at several levels: household hunger, women's hunger, and children's hunger. Although this article discusses the issue of food insecurity in the USA, it is readily applicable to the many nations, communities, households, and individuals in sub-Saharan Africa that face food insecurity. In addition, by noting that different individuals within a given household may face different levels of food security or insecurity, the paper underscores the importance of looking at intrahousehold factors and gender issues.

Celis, R., J.T. Milimo, S. Wanmali (eds.). 1991. *Adopting Improved Farm Technology: A Study of Smallholder Farmers in Eastern Province Zambia*. Washington D.C.: IFPRI.

This is a collection of articles based on primary data collected in Eastern Province, Zambia in 1985/1986. The articles examine the physical, institutional, and policy environment of the province. In addition, they examine determinants and effects of technology adoption, especially the adoption of hybrid maize and related inputs. Households are characterized as adopters or nonadopters of hybrid maize and/or oxen, contact or noncontact farmers, and male- or female-headed households. Among their results, they find that the cultivation of hybrid maize requires substantial amounts of labor, especially women's labor, and that there is a welfare disadvantage to women and children living in households that grow hybrid maize. Policies that would reduce inequities in the region are proposed.

Cheater, A. 1981. Women and their participation in commercial agricultural production: The case of medium-scale freehold in Zimbabwe. *Development and Change* 12: 348–77.

Most of the literature concerning women's role in African agriculture focuses on smallholder peasant families. This paper takes a different approach; it examines women's participation in commercial agricultural production, especially in polygamous households where nonfamilial labor is hired less frequently. The high labor requirements of women are accompanied by less decision-making power and financial independence than in monogamous or peasant households. This is particularly true of junior wives, who have little decision-making power and are economically dependent upon the farm owner and senior wives. The roles of women as workers, farm owners, and farm managers are examined, with particular attention to their varying degrees of decision-making power. The ways in which traditional customs and culture reinforce the increased appropriation of women's labor by their kin suggests that the situation is stable.

Chipande, G.H.R. 1987. Innovation adoption among female-headed households: The case of Malawi. *Development* 18: 315–27.

This study highlights the constraints facing female-headed households in Malawi and underscores many of the reasons that new technologies have not been adopted. Many female-headed households have small plots of land and low levels of income. Thus, credit may not be available to them, and if it is offered, they may choose not to borrow because they would not expect to be able to repay the loans. Low levels of income exacerbate labor shortages for their farms, since they often hire out labor during the peak labor season to provide food for themselves and their families.

Ciparisse, G. 1987. An anthropological approach to socioeconomic factors of development: The case of Zaire. *Current Anthropology* 19(1): 37–41.

For any development project to be effective, it must take into account the specific socioeconomic structures and values of the community it seeks to help. By explaining how the clan structure of the Congo (formerly Zaire) shapes the incentives for the adoption of modern agricultural technology, this paper illustrates the conflicts between traditional social institutions and the implementation and success of projects aimed to increase individual surplus production.

Clark, B.A. 1975. The work done by rural women in Malawi. *Eastern Africa Journal of Rural Development* 8: 80–91.

Using 1970/71 survey data, this paper analyzes the amount of time spent by women in different tasks. The proportion of work done by men and women in maize production in two villages is also presented. Women provided more hours of work than men in planting, weeding, harvesting, and shelling, but not in marketing.

Davison, J. 1987. "Without land we are nothing": The effect of land tenure policies and practices upon rural women in Kenya. *Rural Africana* 27: 19–33.

In Kenya, women produce over 80% of food crops and contribute to cash crop production but own only 5% of the land. Increasing scarcity of land due to a larger population and to a post-independence land boom has eroded women's access to land. During the precolonial period, use rights derived from patrilineages. Plots were allotted to male heads of households according to their needs. In turn, male heads were obligated to provide plots for each of their wives. In 1954, all potential agricultural land was consolidated into private holdings. Title deeds were given to male household heads who were encouraged to produce cash crops. This capitalization of land and agriculture has made women more dependent on men who control agricultural inputs, land, and the distribution of goods and services. While women still acquire access to land through marriage, they are granted fewer plots than women in precolonial times. Single and widowed women face additional constraints. An unmarried woman without children must either find urban employment or return to her father's homestead. A woman may lose her access to land when her husband dies. National development policies are needed that give women the right to inherit land, extend legal protection to widows, and make capital available to women regardless of marital status.

Davison, J. (ed.). 1988. *Agriculture, Women and Land: The African Experience*. Boulder, Colorado: Westview Press.

This collection of articles provides an excellent framework for understanding the relationships of agriculture, gender, and land issues. The introductory chapter provides a clear analysis of the issues. The case studies cover countries throughout Africa and include analyses of both staple and cash crop production. Many of the case studies provide detailed descriptions of women's access to land and how it affects agricultural production. Many of the papers focus on the changes that have been occurring with respect to women's access and tenure of land.

Davison, J. 1992. Changing relations of production in Southern Malawi's households: Implication for involving rural women in development. *Journal of Contemporary African Studies* 11(1): 72–84.

Development projects that require women's cooperative production have met with varied success in Africa. While projects in nations of Africa with long histories of female cooperation, such as Kenya, have proved successful, similar projects in matrilineal societies, such as Malawi, have not. This article stresses the importance of taking socio-cultural considerations into account in planning any development project. In Malawi, land has traditionally been passed through a matrilineage system to individual *banja* households consisting of a wife, her husband, the wife's children, and in some cases her elderly female relatives. Since women maintain complete control of their land and labor, they have little incentive to join together with other women whom they often view as competitors. Rather, women concentrate their efforts on their own land. A recent trend has been for many men to migrate in search of wage employment. Women tend to compensate for this loss by hiring labor rather than cooperating with female relatives. This can be seen as a continuation of the traditional value on autonomy and *banja* profitability and productivity. Women draw most of their labor for maize production from within their family and from hired labor and have little interest in engaging in cooperative activities. Development projects in Malawi should hence be aimed at individual *banja*s rather than cooperative efforts.

de Groot, J. 1991. Conceptions and misconceptions: The historical and cultural context of discussion on women and development. In H. Afshar (ed.), *Women, Development, and Survival in the Third World*. White Plains, New York: Longman Publishing Group. Pp. 107–35.

This paper discusses how historical and cultural issues have shaped attitudes towards women in developing-country societies and the conception and application of development policies. Western scholars have tended to impose "outsider" interpretations on both women and developing nations and to misinterpret and marginalize women's lives. The construct of the non-European other emphasizes difference and discourages comparative and critical analysis of women's resources. It has tended to obscure women's productive roles and has led many social scientists and policymakers to ignore gender differences. Any research, analysis, or policy-making on women in developing nations should consider the inequalities in power, resources, and influence that women face. This paper is most useful for its discussion of the historical roots of women's marginalization and its suggestion of a critical and comparative approach to examining the lives of developing-country women. The marginalization of women's productive role in agriculture is mentioned, although not specifically in regards to maize production.

Dei, G.S. 1991. The dietary habits of a Ghanaian farming community. *Ecology of Food and Nutrition* 25: 29–49.

This paper provides detailed ethnographic data on the methods used by households to process food and prepare meals in southeastern Ghana. Maize is one of the staple crops of this area. Patterns of food distribution and consumption are also noted, with the conclusion that monetary income and agricultural production have some relationship with nutrition status, but that poor households successfully supplement their diets with wild food plants and bush meat.

Delgado, C.L., and C.G. Ranade. 1987. Technological change and agricultural labor use. In J.W. Mellor, C.L. Delgado, and M.J. Blackie (eds.), *Accelerating Food Production in Sub-Saharan Africa*. Baltimore, Maryland: Johns Hopkins University Press.

Understanding patterns of labor use in sub-Saharan African agriculture is critical to the design and adoption of improved technology. Average and marginal labor productivity are generally low; labor productivity varies significantly across even small areas; and labor inputs are subject to high seasonal variability. Where arable land is abundant, the factor share of labor in African agriculture tends to be relatively high. Cobb-Douglass production functions for sub-Saharan Africa are close to unity, which indicates constant returns to scale. In Africa, low population density has kept the marginal product of labor high while the lack of technological change has kept the average product of labor low. Seasonal labor bottlenecks limit the types of technology that can be adopted. The abundance of land heightens the labor shortage because potential laborers can usually farm their own land rather than someone else's. New food production technologies should aim to raise returns per labor hour in the peak season and to raise returns per worker over the agricultural year. This might be accomplished by decreasing the labor input needed to produce a given output, shifting a labor input from peak season to a noncritical period, or raising peak season returns faster than labor requirements.

Dibley, D., D. Boughton, and T. Reardon. 1994. *Processing and Preparation Costs for Rice and Coarse Grains in Urban Mali*. Staff Paper No. 94-34. East Lansing, Michigan: Dept. of Agricultural Economics, Michigan State University.

In Mali, urban households have been shifting consumption from traditional coarse grains, including maize, millet, and sorghum, to rice. This paper examines the differences in total costs between the two types of meals to understand their substitutability. Total costs include the costs of the cereal, processing costs, preparation costs, and the cost of the sauce to accompany the grains. Although the processing costs of the coarse grains are higher than those of rice, the total cost of coarse grain meals is less. However, as the opportunity cost of women's time increases, the full costs of coarse grain meals will rise, since processing time is significantly higher. Decreases in the processing costs of coarse grains through improved technology will be needed to reduce the shifts to rice, which must be imported.

Donhauser, F., H. Bauer, and A. Langyintuo. 1994. *Smallholder Agriculture in Western Dagbon A Farming System in Northern Ghana.* Nyankpala Agricultural Research Report 10. Tamale, Ghana: Nyankpala Agricultural Research Station.

A description of smallholder farming systems in Western Dagbon, Ghana, is developed based on on-farm experiments and an intensive farm management survey of 19 households in 1988. It provides details on the farming systems in the area. Maize is grown on much of the land, often intercropped with millet or sorghum, and groundnuts. Gross margins analyses were done and the highest remuneration per person day of labor was for maize, sorghum, and groundnuts in that particular year. However, 1988 was a favorable year for cereals and a poor year for yams. The paper develops a model farm, and discusses the labor requirements, by seasons, for men and women. The authors conclude that researchers should focus on increasing labor productivity.

Doss, C.R. 1996. Testing among Models of Intrahousehold Resource Allocation. *World Development* 24(10): 1597–1609.

Five categories of models of intrahousehold resource allocation are presented. They differ based on their assumptions regarding whether all individuals make a unified production and consumption decision and whether the outcome of household decisions is Pareto efficient. Each of the models has predictions that can be tested using household survey data. The empirical literature on intrahousehold resource allocation, much of which examines African households, is analyzed to determine how the results are related to the different models.

Doss, C.R. 1997. The effects of women's bargaining power on household health and education outcomes: Evidence from Ghana. Paper presented at the Population Association of America Meeting, 1997, Washington, D.C.

Women's bargaining power within the household, measured by the share of assets within the household owned by women, is shown to affect household decisions, including household expenditure patterns, and health and education outcomes for children.

Due, J., and R. Summary. 1982. Constraints to women and development in Africa. *Journal of Modern African Studies* 20(1): 155–66.

Although this article is primarily about the constraints limiting African women's movement into formal wage sectors, it makes several points that are relevant to women farmers. In particular, it argues that the two most important constraints facing women are the lack of access to formal education and capital.

Due, J.M., and M. White. 1986. Contrasts between joint and female-headed farm households in Zambia. *Eastern Africa Economic Review* 2(1): 94–98.

Using survey data collected on 112 farm women in Zambia, comparisons are made between female-headed households and joint households. Women are farmers in both types of households. Maize area is significantly smaller for female-headed households. However, female-headed households plant a significantly larger portion of their total area to maize than the joint families. In general, female-headed households are smaller, poorer, receive fewer extension visits, have less access to new technologies and credit, and have greater need for labor-saving devices.

Due, J.M., E. Sikapande, and F. Magayans. 1991. Does the T&V extension assist female headed-families? Some recent evidence from Zambia. *East Africa Economic Review* 7(1): 69–75.

Initial successes with the Training and Visit (T&V) extension system prompted the World Bank to encourage African governments to replace their existing systems with T&V. This paper evaluates the results of a pilot test of T&V in Zambia in 1983/4. Contact farmers benefited the most, while female-headed households (which constitute 30% of farm households) were largely ignored. This article offers interesting insights into farmers' views of T&V, including differences between male and female heads of households. Maize is not specifically mentioned, but the ineffectiveness of T&V in reaching female farmers has relevance to any extension project. The paper concludes by suggesting some policy changes which would make T&V more effective under Zambian conditions, especially for female-headed households.

Eicher, C.K. 1995. Zimbabwe's maize-based green revolution: Preconditions for replication. *World Development* 23(5): 805–18.

Zimbabwe provides an example of how a maize-based green revolution may occur in Africa. Zimbabwe's first green revolution was led by politically active commercial farmers who wanted institutional innovations, public investments in agricultural research and infrastructure, guaranteed farm prices, and export marketing schemes. The second green revolution was led by smallholders who were able to take advantage of the infrastructure created earlier. The paper details the conditions necessary to replicate Zimbabwe's experiences and provides caution regarding the problems of sustainability.

Ezumah, N.N., and C.M.D. Domenico. 1995. Enhancing the role of women in crop production: A case study of Igbo women in Nigeria. *World Development* 23(10): 1731–44.

Among the Igbo of Nigeria, yams are considered a male crop, while female crops include cocoyams, cassava, beans, maize, and vegetables. However, the patterns of cropping by gender are changing, particularly in areas where people have migrated to become tenant farmers. Men may grow women's crops as cash crops and women have taken over many traditionally male tasks.

Feldstein, H.S., and S.V. Poats. 1989. *Working Together: Gender Analysis in Agriculture.* West Hartford, Connecticut: Kumarian Press.

This two volume series contains a set of case studies of agricultural development projects and teaching notes to guide discussions. Three of the case studies are of farming systems research projects in Africa, including projects in Botswana, Burkina Faso, and Zambia. In addition, there is a case study of an agroforestry project in Kenya.

Ferguson, A.E. 1994. Gendered science: A critique of agricultural development. *American Anthropologist* 96: 540–52.

Using a case-study from Malawi, Ferguson argues that science itself is a gendered enterprise. The case study focuses on an interdisciplinary collaborative agricultural research project aimed at improving bean production. Researchers interviewed male farmers and decided that the differences in varieties found within fields were caused by environmental and biological factors rather than by human selection. The farmers interviewed did not seem to know much about the different varieties. Subsequent research showed that beans are typically a women's crop and that women farmers possess intricate knowledge and preferences for the different varieties of beans grown. Variation in the extent of knowledge that women farmers possessed was the result of economic factors; better-off women possessed more knowledge and grew more varieties of beans on their plots. These insights were incorporated into a more appropriate crop improvement strategy. In this case study, the gender assumptions of the agricultural researchers influenced the conduct of their science. By documenting the differences in knowledge and goals of male and female farmers, and between female farmers, this case study demonstrates that recognizing the diversity of perspectives of researchers and of farmers is essential to agricultural research programs. While this article does not mention maize, the theory of gendered science provides insights into farming systems in Africa that are relevant to programs for any crop.

Fortmann, L. 1976. Women and Maize Production: Some Tanzanian Observations. Dar es Salaam, Tanzania: Protein Calorie Advisory Group of the United Nations. Mimeo.

This is an early paper that poses the issues and sets out a research agenda on gender and maize. Maize has long been considered a woman's crop in Tanzania. In 1975, the National Maize Project offered maize inputs to farmers at subsidized prices. While women did not purchase the inputs as much as men, those women who purchased the inputs performed as well as their male counterparts. Participants and nonparticipants differed significantly in their maize production knowledge. Women nonparticipants had significantly lower knowledge than male nonparticipants. Although the information system may have been generally ineffective, women had less access to extension contact and published material (due to the higher incidence of illiteracy among women). Several possible explanations of women's low participation are explored. Whether a woman owns the land she farms is significantly related to input use. Access to credit and inputs, and lack of control of produce were offered as possible explanations, but no data are available to quantify these hypotheses.

Fortmann, L. 1980. *Women's Involvement in High Risk Arable Agriculture: The Botswana Case.* Washington, D.C.: Office of Women in Development, USAID.

While Botswana is ideally suited for cattle production, arable agriculture remains an important, but risky, activity. Women farmers, in particular, are marginalized because of their lack of access to draft power and to labor. Female-headed households often must hire labor and animal traction to plow their fields while male-headed households can exchange surplus labor or use their own stock. In addition, women have higher household cash outlays and typically are asset poor compared to men. Although arable agriculture is rarely profitable for either male- or female-headed households, there are reasons for wanting to keep women in agriculture. In this matrilineal society, land is the one asset that women farmers universally possess. As population pressure increases and competition for land increases between farmers and cattle raisers, this land may become more valuable. In the meantime, policies could be implemented to ease the burden of women farmers and mitigate their input constraints. Possibly, policies could steer women towards crops that minimize draft and labor, such as maize, or that lessen women's other time-consuming tasks, such as fetching water.

Francis, E., and J. Hoddinott. 1993. Migration and differentiation in Western Kenya: A tale of two sub-locations. *The Journal of Development Studies* 30(1): 115–45.

Two micro studies examine how rural/urban relationships have influenced economic and social mobility. In the 1950s, increased urban employment opportunities in Kenya encouraged rural-to-urban migration. Men migrated to the cities and sent remittances to their families in rural areas. Today, the main sources of income for rural families are remittances and nonagricultural rural employment rather than agricultural output. Many migrants are reluctant to invest in agriculture because they believe it is less productive than investments in urban real estate, small business ventures, and children's education. This low level of investment, the loss of labor to urban centers, and the decreased productivity of land, has not been compensated for by widespread adoption of agricultural technology. Successful migrants are increasingly focused on urban markets; their ties and feelings of responsibility for rural areas are weakening. To the extent that opportunities for agricultural production and investment are determined by family income, this trend in urban-to-rural migration may have serious repercussions for rural farmers' ability to invest in productivity-enhancing technology. Seventy-one percent of farmers grow local maize varieties and 63% grow hybrid maize. Since maize is the staple crop, understanding the changing constraints imposed by the rural/urban relationship will therefore be crucial to any maize-related development project.

Franzel, S.C. 1984. Modeling farmers' decisions in a farming systems research exercise: The adoption of an improved maize variety in Kirinyaga District, Kenya. *Human Organization* 43(3): 199–207.

This article examines farmers' decisions regarding the adoption of the composite maize variety, Katumuni. Data were collected using both informal and formal surveys. The informal survey indicates that farmers make two separate decisions on maize varieties. They decide which variety, if any, to grow of early maturing maize to prevent pre-harvest food shortages and which variety to grow for the main stock of maize to be consumed or sold throughout the year. Although research and extension trials indicate that yields of Katumuni are higher than traditional varieties, farmers reject the composite variety as their main crop because they claim its yields are lower than traditional varieties except in times of low rainfall. Differences between management of the trials and farmer practice may account for the discrepancy. Despite a preference for higher yielding traditional varieties, most farmers grow some Katumuni because it matures early and can ease the "hunger period." A medium-maturity variety with good husk cover and storage characteristics and high yields in normal rainfall periods should be introduced because it would be readily adopted by Kenyan farmers. Gender issues are not addressed in the article.

Franzel, S., and H. van Houten (eds.). 1992. *Research with Farmers: Lessons from Ethiopia*. Addis Ababa, Ethiopia: CAB International for the Institute of Agricultural Research, Ethiopia.

This edited volume reports on the lessons learned from collaborating with farmers to identify problems and experiment with solutions. Two sections of the book deal with regions of Ethiopia that include maize as an important crop. A number of problems facing farmers were identified, including the shortfalls of food available during the pre-harvest season, peak-season labor shortages, and land shortages. Experiments with new varieties and technologies were undertaken and farmers' reactions are reported. Gender issues are not specifically addressed, although the section describing the farming system in Bako pays attention to gender divisions of labor.

Freudenberger, K.S. 1994. New Technology for rural women: Paradoxes of sustainability. *Development in Practice* 4(1): 13–22.

The limited adoption of technology in West Africa is due to economic constraints faced by poor farmers. The ability to pay affects the benefits of technology, the distribution of benefits, and sustainability. This article examines the effective demand for mechanized mills in Senegal and the Gambia. These mills were designed to relieve women's high work load. Unfortunately, most of the mills that have been installed either are not working or are operating at an economically unsustainable level. Women farmers generally do not have enough capital to use the mills regularly. Experience with mills and dehullers suggests that sustainability depends upon effective consumer demand, reliable operation of the machinery, and good management procedures. The cost of processing adds as much as 25-50% of the value of the grain and roughly doubles the amount a women spends on all her weekly purchases. The low effective demand keeps the number of people who benefit from this development intervention low and weights this benefit in favor of wealthier section of the population who can afford the relative luxury. While labor-saving technology for rural women pursues a socially desirable goal, it often falls short because rural women do not have sufficient income to take advantage of it.

Frischmuth, C. 1998. From crops to gender relations: Transforming extension in Zambia. In I. Guijt and M.K. Shah (eds.), *From Myth to Community: Gender Issues in Participatory Development.* London: Intermediate Technology Publications.

This case study details how simply expanding an extension program so that it was participatory did not result in the anticipated changes in productivity and well-being. Once gender issues were explicitly addressed by the program, many of these changes began to occur. Couples were encouraged to attend meetings together and men and women were encouraged to express their concerns and preferences. It became clear that men and women had different priorities for the extension service. The authors conclude that gender is not the sensitive topic that some claim it is and that it can be discussed and dealt with by extension staff.

Geisler, G. 1992. Who is losing out? Structural adjustment, gender, and the agricultural sector in Zambia. *The Journal of Modern African Studies* 30: 113–39.

This article argues that the recent decline in agricultural production in Zambia is the result of decades of mismanagement and inappropriate policies under structural adjustment programs. Adverse effects on maize production of government policies from 1980 to 1992 are examined. After the liberalization of the maize market in September 1990, maize marketing reached a virtual standstill. Because of insufficient infrastructure and transportation and debt-ridden cooperatives, most maize was not sold and many farmers never received payments. Some Zambian farmers in the border area smuggled their crop to Malawi to realize the higher prices offered there. Smallholders rapidly shifted to more profitable crops that need fewer purchased inputs and had more secure marketing channels. This downward trend in maize production is likely to continue since resources and incentives for small-farmers are decreasing. Structural adjustment measures have affected various social and economic groups differently. The social costs have been borne most heavily by the poor, particularly women.

Structural adjustment programs rapidly induced drastic economic changes, which effected changes in patterns of cropping, incomes, allocations of time, and patterns of consumption. These changes are outlined and their effects on women are explored.

Gilbert, E., L. Phillips, W. Roberts, M.-T. Sarch, M. Smale, and A. Stroud. 1994. *Maize Research Impact in Africa: The Obscured Revolution.* Bureau for Africa Technical Paper 07. SD Publication Series. Washington D.C.: Office of Sustainable Development, USAID.

This study examines the effect of maize research by comparing actual production in sub-Saharan Africa with two hypothetical scenarios. The first scenario has static yields which remain at the average five-year level for 1966–70. The second scenario has yields falling by 1% per year. The authors differentiate between, and attempt to account for, easily achieved results (area, yield, production, prices), obscured changes (returns to labor, resource allocation, consumption, etc.), and invisible impacts (avoidance of negatives such as pest, disease, drought, and low soil fertility.) Case studies are presented from five countries: Kenya, Malawi, Senegal, Nigeria, and Zaire, as well as regional overviews and historical background on development trends. The authors claim that improvements in maize production, especially technical innovations, including mechanization, germplasm, and post-harvest techniques, have had positive effects on domestic availability of grain, food security, consumption levels, trade balances, and economic growth. The authors acknowledge the difficulty of including all research impacts and generalizing across varied geographical regions. However, evidence indicates that research contributes to increased returns to land and labor and that increased production was due to technical innovations—not just an expansion of the area under cultivation. At the household level, improved techniques help relieve constraints, by either allowing an expansion of maize production or a shift of resources out of maize production, depending on the particular needs of the household.

Gladwin, C.H. (ed.). 1991. *Structural Adjustment and African Women Farmers.* Gainesville, Florida: University of Florida Press.

This collection of articles provides both a series of case studies and an analysis of the issues affecting women farmers in Africa in countries that are undergoing structural adjustment. Although the title suggests that the book focuses on women farmers, individual chapters include rural women more broadly defined and women traders. The final chapters focus on directions for research and policy to improve the lives of women farmers.

Gladwin, C.H. 1992. Gendered impacts of fertilizer subsidy removal programs in Malawi and Cameroon. *Agricultural Economics* 7: 141–53.

Gladwin explores the affects of removing fertilizer subsidies on women farmers. After reviewing the standard arguments for and against such subsidies, she claims that even with existing levels of fertilizer subsidies, fertilizer use is suboptimal in both Malawi and Cameroon. A removal of the fertilizer subsidy and the resulting increase in fertilizer prices could decrease fertilizer use to lower levels, especially among women, because imperfect credit and the lack of cash are the main constraints limiting women farmers' use of chemical fertilizers. Since maize is fertilizer responsive and because there are no viable organic substitutes for chemical fertilizer in the local farming systems at this time, a decrease in fertilizer use will decrease maize production. The result will not only decrease women's agricultural production and incomes, but will also jeopardize the high level of food self-sufficiency currently enjoyed by both countries. She recommends a policy of maintaining or increasing fertilizer subsidies in both countries and of targeting subsidies toward smallholders, especially women farmers, for food production.

Goetz, S.J. 1993. Interlinked markets and the cash crop-food crop debate in land-abundant tropical agriculture. *Economic Development and Cultural Change* 41(2): 343–60.

This paper explores the relationship between cash-crop production and food-crop production in sub-Saharan Africa. Goetz argues that indigenous institutions within the household have been developed to cope with market failures. Consequently, policies that affect the linkages among land, labor, and capital within the household influence the amount of land and resources dedicated to food and cash crops. Using data from Senegal, this article shows that increasing prices for cash crop inputs may decrease the amount of cereal crops, such as maize, that are grown. When cash crops are produced, the household head provides seed, land, and assurance of food sustenance. In exchange, other members of the household work a designated number of hours on a family cereal plot. The provision of cash-crop inputs to household members assures the household head of a sufficient labor pool, which includes married sons and migrant workers. The results indicate that net cereal production is higher when cash crops are produced. Although one might imagine that interhousehold markets might differ for female-headed and male-headed households, this paper assumes the household head to be male.

Goheen, M. 1996. *Men Own the Fields, Women Own the Crops: Gender and Power in the Cameroon Grassfields*. Madison, Wisconsin: University of Wisconsin Press.

In this book, the author discusses gender and power relations throughout a number of institutions within the

Nso' chiefdom. In the section on gender and power relations in agricultural production, detailed descriptions of tensions between the roles and responsibilities of men and women are provided. Men continue to own the land, yet women produce much of the food and are responsible for feeding their families. These relationships are contested and much of the book focuses on how they are contested and how they change.

Grenoble, D.W. 1990. Mechanization in a developing country—Swaziland. *Applied Agricultural Research* 5(3): 235–40.

Labor shortages limit maize and vegetable production in Swaziland. Around 90% of arable land is dedicated to maize production. During the rainy season most farmers focus on maize and do not farm their irrigated plots. This paper proposes specific improvements in mechanization to ease labor shortages and increase land area under production. Research trials tested the effectiveness, availability, and affordability of different interventions such as herbicides, oxen-drawn maize planters, and reduced tillage methods. Based upon the results, the author offers proposals for improving mechanization. The paper warns that mechanization will likely be slow due to the scarcity of capital and farmers' aversion to risk. No discussion is made of how mechanization might affect men and women farmers differently or whether women would be less likely to adopt the technology. This paper is most useful for its recommendations concerning affordable improvements to already existing maize technology.

Grisley, W., and D. Mwesignwa. 1994. Socio-economic determinants of seasonal cropland fallowing decisions: Smallholders in South-Western Uganda. *Journal of Environmental Management* 42: 81–89.

This article examines the socioeconomic factors that determine fallowing decisions of smallholders in southwestern Uganda. The relationship between farm and household factors and the degree of fallowing is estimated. Factors positively associated with fallowing include the size of the field on which the homestead is located, farm acres per family member, percent of cultivated land that is currently intercropped, and the percent of land that is located on hillsides. The number of days per week that the wife worked off-farm was found to be negatively associated with fallowing. No association was found between either household labor availability or the distance of fields from the homestead and fallowing decisions. Intercropping is advocated as an appropriate short-run method for maintaining soil fertility and reducing soil loss. The most common intercrop combination in the area is maize and beans. Although men and women might have different preferences for fallowing or cultivation, gender is largely ignored in this article.

Guyer, J. 1980. *Household budgets and women's incomes*. Working Paper 28. Boston: African Studies Center, Boston University.

This is an important anthropological work challenging the notion of a single household budget, using a case study of the Beti in Cameroon. The author demonstrates that men and women maintain separate purses. Women have been increasingly brought into the food trade in this region. The men's economy has a clear peak during the cocoa season, and women also increase their income-generating activities during this period to take advantage of the additional cash in the local economy. Although the study area is not primarily a maize producing area, this is a useful analysis of intrahousehold relations in agricultural households in an area undergoing economic changes.

Guyer, J.I. 1988. Intra-Household Processes and Farming Systems Research: Perspectives from Anthropology. In J.L. Moock (ed.), *Understanding Africa's Rural Households and Farming Systems*. Boulder, Colorado: Westview Press. Pp. 92–104.

In order to understand gender issues in Africa, Guyer stresses that it is critical to examine the processes of agricultural change. In particular, it is important to examine intrahousehold processes in order to begin to understand how patterns of production and consumption change. She argues that analyses at the household level are inappropriate for Africa and proposes an approach to move beyond it.

Guyer, J. 1997. *An African Niche Economy*. Edinburgh, UK: Ediburgh University Press.

Most discussions of food production in Africa focus on the failures. This book provides interesting insights by discussing how the areas around Ibadan, Nigeria have changed during1968–1988, but have continued to provide food for the rapidly growing city. One chapter focuses on women's entry into farming. Women went into farming specifically for the urban market and were frequently specialized commercial farmers.

Hailu, Z. 1990. *The Adoption of Modern Farm Practices in African Agriculture: Empirical Evidence about the Impacts of Household Characteristics and Input Supply Systems in the Northern Region of Ghana.* Nyankpala Agricultural Research Report 7. Tamale, Ghana: Nyankpala Agricultural Experiment Station.

The empirical analysis in this study is based on a case study in northern Ghana during the 1986/87 cropping season. Maize is a staple crop in this area. After a brief discussion of the socioeconomic characteristics of the study area and of its prevailing farming systems, the objectives and tools of agricultural policy in the region are presented. Prevailing input supply and distribution systems are described in great detail with emphasis on institutional and operational setups.

A theoretical framework governing technical adoption at the farm level is developed and the effects of factor-saving options are compared to traditional alternatives. A model of the decision behavior of farm households with respect to innovation adoption is developed, but this model did not consider possible gender effects. The impacts of selected household factors (labor capacity, education, age of household head) and characteristics of input supply and distribution systems (frequency of extension contact, storage capacity, distance to supply centers and local sales points, access to credit) are empirically examined for their impact on technological adoption. Both household and extension variables are statistically significant in the adoption of agricultural technology. This study concludes that availability of inputs at the local level is a significant determinant of adoption.

Hansen, A. 1994. The illusion of local sustainability and self-sufficiency: Famine in a border area of Northwestern Zambia. *Human Organization* 53(1): 11–20.

Self-sufficiency, often conceptualized as adequate staple food production for village consumption, may not be an appropriate goal. This case study from Zambia's North-Western Province underscores the complexity and fragility of sustainability. For many years, the farming systems of cassava production evolved to meet the growing needs of a rapidly expanding population of immigrants and refugees. But during 1985–1989, a mealybug invasion destroyed most of the staple crop and instigated a famine. The famine was caused by the interaction of ecological, political, and economic factors. Many farmers responded by switching to the production and consumption of local and imported varieties of maize. Political and economic factors limited the availability of inputs, such as fertilizer, especially in border areas. This paper underscores the incorporation of villagers within a larger ecological, political, and economic framework and stresses that their resourcefulness is essential to the evolution of food production systems and coping with famine. Although gender is not mentioned, this paper provides a useful discussion of how maize became an important staple crop in Zambia as a result of the resourcefulness of villagers under ecological, political, and economic distress.

Heisey, P.W., and M. Smale. 1995. *Maize Technology in Malawi: A Green Revolution in the Making*? CIMMYT Research Report No. 4. Mexico, D.F.: CIMMYT

This research report examines whether the diffusion of improved germplasm and fertilizer in Malawi will create the aggregate yield gains associated with green revolutions. Any significant increases in maize production in Malawi must come from increased yields rather than the expansion of cultivated area. The new technologies are particularly attractive to smallholders, which suggests that increased yields will have positive benefits on income distribution. Farmers are widely adopting seed/fertilizer technologies. The hybrids in Malawi yield better than the local varieties, even with low inputs. The newest semi-flint hybrids are demonstrating that it is not necessary to sacrifice yield to obtain the grain texture characteristics preferred by smallholders. The authors recommend public/private collaboration in research as necessary for continued success. Gender is not a focus of this paper, but the authors specifically address smallholder farmers, many of whom are women.

Heisey, P.W., and W. Mwangi. 1996. *Fertilizer Use and Maize Production in Sub-Saharan Africa.* CIMMYT Economics Working Paper 96-01. Mexico, D.F.: CIMMYT.

To increase food production in Africa, soil fertility must be managed more efficiently. This paper examines the role of fertilizer use in maize production in Africa and develops recommendations for fertilizer policy. There is a strong link between fertilizer use and maize production. The adoption of fertilizer depends on the price, the risk aversion of the farmers, and credit and cash constraints. In addition, there are constraints to increased supply, including high purchase and distribution costs. Two recommendations follow from the analysis. First, governments should concentrate on providing information, enhancing legal institutions, and improving infrastructure. Over time, governments should become less directly involved in procuring and subsidizing fertilizer. In addition, future studies must pay attention to the institutional details of policy making. Because policy is often made in a second-best environment, it is critical to understand institutional considerations.

Hill, P. 1975. The West African farming household. In J. Goody (ed.), *Changing Social Structure in Ghana*. London: International African Institute. Pp. 119–36.

This paper details the early anthropological studies of the gender division of labor in West Africa. It provides a useful framework from which to examine the changes that have occurred in the recent decades.

Hill, P. 1978. Food-farming and migration from Fante villages. *Africa* 48(3): 223–30.

Among the Fante villages of southern Ghana, men and women traditionally married and formed a symbiotic farming unit. The production of the staple crops, maize and cassava, relied upon a division of labor within the household as hired labor was, and is, widely unavailable. Despite this, the institution of marriage has declined; half of the men and women interviewed who were once married are no longer married and are disadvantaged as cultivators by their inability to secure labor. This article examines the sociological sources for the high rate of food farmers without spouses and contends that it leads to extreme inefficiency of farming in the region. High rates of outward migration seem related to decreased incentives to farm and the lack of lucrative nonagricultural employment for men

within the villages. Migration decreases the total availability of labor for farming and increases the number of farmers without spouses. Despite its negative ramifications, migration is encouraged by the older generations who do not want their sons and daughters to farm. This article is useful for its analysis of the changing relationships in maize production between men and women and for its analysis of how shifting household structures impact maize production.

Hirschmann, D., and M. Vaughan. 1983. Food production and income generation in a matrilineal society: Rural women in Zomba, Malawi. *Journal of Southern African Studies* 10(1): 86–99.

Women are heavily involved in agriculture in the Zomba District of Malawi and have a strong history of access to land. With increasing land shortages, women are feeling pressures and becoming more dependent on wages, especially male wages. The majority of women interviewed for this study do not have enough land for economic independence or to produce the maize needed for their households. Household structure is changing as the numbers of female-headed households increase. This paper examines the patterns of food production and income generation among women in the context of their households.

Hirschmann, D., and M. Vaughan. 1984. *Women Farmers of Malawi: Food Production in the Zomba District.* Berkeley, California: University of California.

This report offers valuable information on women farmers in Malawi. The data were provided by a microstudy of women in the Zomba district where maize is the staple crop. The findings of the survey clarify the role of women in agriculture. An estimate of the number of households effectively headed by women is given. Both the sexual division of labor in different types of households located in different geographical zones, and the sexual decision-making responsibilities concerning agricultural production, the sale of products, and household expenditures are described. Women farmer's assessments of extension officers, credit policies, and the problems specific to women are provided. The data on decision-making and division of labor were gathered by survey response, not by observation. The insights they provide into women's expressed attitudes about farming could be useful in understanding the production of maize and other crops.

Holmboe-Ottesen, G., and M. Wandel. 1991. Men's contribution to the food and nutritional situation in the Tanzanian household. *Ecology of Food and Nutrition* 26: 83–96.

As more emphasis is being placed on women's contribution to agriculture in Africa, this paper examines the roles of men and the interactions of men's and women's activities in agricultural production. They find no effect of men's labor in agriculture on children's nutrition levels. They note that the policy challenge is to increase men's contribution to food production without decreasing women's roles and women's decision-making and control.

Honfoga, B. 1993. Maize acreage response under differential prices in the Republic of Benin, West Africa. *Agricultural Economics* 9: 215–39.

This paper estimates the responses of maize acreage to both urban and rural prices in Benin. Urban prices are statistically related to maize acreage, whereas rural prices are not. There is no distinction as to which farmers are responding to these changing prices and how the prices affect the well-being of different groups of farmers.

Howard, J.A. 1994. Improved maize in Zambia: A qualified success story. Paper presented at the American Agricultural Economics Association Meeting, August 7–10, 1994, San Diego, California.

Maize is Zambia's most important crop. This paper outlines the history of maize varietal development, adoption, and maize-related policies and examines their effects. The impact of investments is stressed; it is hypothesized that the adoption of new technology is closely linked to investments in the seed industry, extension, and marketing and favorable price policies. Evidence from a recent field survey is used to examine production changes and to calculate the average rate of return to research and complementary inputs. The findings indicate that government policy has skewed incentives towards maize production. The major impact of policies such as pan-seasonal pricing, investments in marketing facilities, provision of subsidized credit, and input packages is to facilitate the production of maize by rural farmers in remote areas and to diminish large-scale farmer production nearer to consumption centers. Producer surplus was shifted from large-scale farmers to small- and medium-scale farmers. Urban consumers also benefited. It is noted that if policy recommendations are made assuming a rate of return calculated in isolation from the costs of complementary organization, critical issues may be missed or misinterpreted. Gender is not mentioned in this paper, but the paper does demonstrate the ability of policy to transfer producer surplus to traditionally disadvantaged groups.

Howard, J.A., and C. Mungoma. 1996. *Zambia's Stop-and-Go Revolution: The Impact of Policies and Organizations of the Development and Spread of Maize Technology.* East Lansing, Michigan: Dept. of Agricultural Economics, Michigan State University.

This paper explores how Zambia's policy environment influenced the adoption and dissemination of maize technology from 1964 to 1992. After independence, Zambia improved the infrastructure of its state marketing system, subsidized fertilizer, maintained pan-seasonal pricing, subsidized maize meal to urban consumers, and encouraged input adoption by offering credit packages to smallholders

wishing to grow maize. These policies caused a redistribution of production from commercial farmers along the railroad to smallholder farmers in more remote areas and led to a significant increase in the amount of land under maize production. These policies proved to be economically unsustainable and have been gradually removed since the late 1980s. The result has been a shift away from maize production, especially in remote areas. No mention of gender is made in this paper. Its major contribution is the insight it offers into how policy shaped the adoption patterns of maize in Zambia.

Ikpi, A. 1992. Household time allocation—The ultimate determinant of improved agricultural technology adoption in Nigeria: An empirical activity interphase impact model. In G.H. Peters and B.F. Stanton (eds.), *Sustainable Agricultural Development: The Role of International Cooperation.* Dartmouth, UK: International Association of Agricultural Economists. Pp. 481–501.

Households engage in activities in three sectors: the farming sector, non-farming commercial activities, and the non-monetized home production sector. This paper presents detailed descriptions of time use for a nationally representative sample of Nigerian households. The authors demonstrate that the introduction of a new technology in the farming sector will shift the balance of labor allocation in all three activity sectors of the household.

Jackson, C. 1985. *The Kano River Irrigation Project*. West Hartford, Connecticut: Kumarian Press.

The Kano River Project was designed to implement new methods of irrigation in the Hausaland region of northern Nigeria. Results of the project were mixed: land reallocation was inefficiently implemented, living standards were not significantly improved, participants in the project expressed a feeling of disruption, and unforeseen difficulties arose. There are two vastly different social structures in the project area. The majority of the Hausa (95%) are Muslim and practice wife seclusion. This gives rise to highly separate spheres of activity for men and women. These secluded Muslim women are mainly petty commodity producers, whose limited agricultural work is often paid in kind. Muslim women have experienced both positive and negative effects from the project. They have been able to expand their role as snack food producers and have adapted to changes in supply and demand. Non-Muslim women, on the other hand, play a much more integral role in farm and household work. The project had detrimental effects on these women because firewood and other inputs for beer making became less available. In addition, more of their time was required on family farms as opposed to their own plots. Women were not consulted in any way in the implementation of this project. One interesting result of the project is that seclusion is becoming increasingly popular and marriage ages are declining.

Jackson, C. 1995. From conjugal contracts to environmental relations: Some thought on labour and technology. *IDS Bulletin* 26(1): 33–39.

The gender division of labor usually suggests that tasks are clearly defined by gender. The author claims that it is important to consider conjugal contracts, which specify responsibilities, but there are many ways that women can fulfill these responsibilities. For example, in several different areas in Zimbabwe, the responsibility for processing grain may involve grinding it oneself or taking it to mills. Maize is preferred to other grains, such as sorghum or millet, because it is easier to process. However, the author notes that the link between sustaining the environment and improving women's lives is not necessarily clear in this case—women prefer maize even when other grains are more environmentally appropriate.

Jansen, H.G.P. 1993. Ex-ante profitability of animal traction investments in semi-arid Sub-Saharan Africa: Evidence from Niger and Nigeria. *Agricultural Systems* 43: 323–49.

In Niger and Nigeria, millet is the primary staple crop. Animal traction with oxen is found to be profitable only in conjunction with cash crops such as cotton or cowpea. In areas with closed or nearly closed land frontiers, animal traction investments are not likely to be profitable because they depend critically on the availability of fallow land. The results can not be generalized to other areas of maize production. Many factors in animal traction adoption are region specific, such as the presence of the tse-tse fly, available grazing land, and climactic variables.

Jayne, T.S., and M. Rukuni. 1993. Distributional effects of maize self-sufficiency in Zimbabwe. *Food Policy.* Pp. 334–41.

The authors examine the effects of policies to promote maize self-sufficiency in Zimbabwe. They conclude that there may be a significant trade-off between self-sufficiency in food production and food affordability. Approximately 40% of rural farmers are maize purchasers. In the poorer areas, this number may be significantly higher. These farmers are net purchasers due to the binding constraints of limited land, oxen, and the need for non-farm income to finance inputs. Policies to promote self-sufficiency in maize benefit a small number of relatively wealthy commercial maize farmers at the expense of net purchasers of maize in urban and rural areas. The authors suggest that a policy of self-reliance involving imports, rather than self-sufficiency, should be established.

Jayne, T.S., and S. Jones. 1996. *Food marketing and pricing policy in eastern and southern Africa: Lessons for increasing agricultural productivity and access to food.* East Lansing, Michigan: Michigan State University.

This study examines grain marketing and pricing policy in eastern and southern Africa. The authors find that where smallholder grain production has expanded through the use of hybrid seeds and fertilizer, the state has invested in infrastructure, including markets for outputs, inputs, and credit. The marketing systems were used to transfer resources to select farmer groups, not urban consumers.

Jha, D., and B. Hojjati. 1993. *Fertilizer Use on Smallholder Farms in Eastern Province, Zambia.* Research Report 94. Washington, D.C.: IFPRI.

This study, conducted in Eastern Province, Zambia, examines how farmers use fertilizers and analyzes how fertilizer use facilitates the transition from subsistence farming to more commercialized agriculture. While gender issues are not the focus of the analysis, the sex of the household head is included as a possible determinant of fertilizer use. The sex of the household head is not significant in determining fertilizer adoption or intensity of use. However, female-headed households are likely to use fertilizer on local maize and are less likely to grow hybrid maize. This paper suggests that female-headed households may emphasize family food production and sales. Their lack of male labor may limit their ability to grow hybrid maize and to engage in cash transactions.

Jones, C. 1983. The mobilization of women's labor for cash crop production: A game theoretic approach. *American Journal of Agricultural Economics.* Pp. 1049–54.

This study provides empirical evidence to reject the neoclassical model of the household. It uses data from a study on how husbands mobilize their wives' labor for irrigated rice production in Cameroon. Labor is not allocated efficiently across men's rice fields and women's sorghum fields. One of the reasons for this inefficiency is disagreement between husbands and wives about how the income from rice production should be allocated. Women are unwilling to contribute their labor to male-controlled fields unless they are adequately compensated. This study contributes to our understanding of how intrahousehold dynamics affect the adoption of agricultural technologies.

Kariuku, J.G. 1990. *The Economic Impact of the Adoption of Hybrid Maize in Swaziland.* Kiel, Germany: Wissenschaftsverlag Vauk Kiel.

This book examines the economic impact of the adoption of hybrid maize in Swaziland and concludes that the adoption of maize had different impacts under different farming systems. Very detailed results are presented on a variety of aspects of farming in Swaziland. Gender issues are not explicitly addressed.

Keller, B.B., E.C. Phiri, and M. Milmo. 1990. Women and agricultural development. In A.P. Wood, S.A. Kean, J.T. Milimo, and D.M. Warren (eds.), *The Dynamics of Agricultural Policy and Reform in Zambia*. Ames, Iowa: Iowa State University Press. Pp. 241–62.

This collection of articles provides a detailed analysis of agricultural policies in Zambia. Five sections include a historical overview, natural resource management, agricultural planning, agricultural services, and market-oriented agriculture. Maize is the primary staple crop, and many of the chapters focus on policies relating to maize. In addition, several of the chapters explicitly address issues regarding women farmers in Zambia.

Kennedy, E., and T. Reardon. 1994. Shift to non-traditional grains in the diets of East and West Africa: Role of women's opportunity cost of time. *Food Policy* 19: 45–56.

Over the last 20 years, consumption patterns of sub-Saharan Africa have shifted from traditional coarse grains (mainly maize, millet, and sorghum) to non-traditional varieties, primarily wheat and rice. This paper compares aggregate-level trends in the production and consumption of coarse and non-traditional grains in East and West Africa. Household-level data from urban and rural areas of Burkina Faso and Kenya suggest that urbanization, women working outside of the home, and women's education have shifted consumption to rice in urban Burkina Faso and to wheat (in bread) in Kenya. Changes in women's value of time have contributed more to this shift than changes in household income. This paper suggests that to make maize and other traditional coarse grains more attractive to urban consumers, particularly women, processing time must be reduced.

Kershaw, G. The changing roles of men and women in the Kikuyu family by socioeconomic strata. *Rural Africana* 29: 173–94.

Colonial land tenure reforms and the shift from a land abundant to land scarce society have resulted in changes in the balance of decision-making power between male and female farmers. Currently, decision-making patterns vary among three different socioeconomic groups. The largest group is composed of families with little or no land. In this group, women are responsible for providing for almost all of their family's needs. Women's responsibilities have increased significantly, and their decision-making power has increased proportionally. There is little possibility of adopting new varieties of maize or fertilizer because land tenure and subsistence are too uncertain to take risks. In the middle group, families own enough land to reach subsistence or produce a small surplus. Women have less access to land than before because their husbands allocate more land to cash crops, but women have gained some economic independence through remuneration for their labor on these cash crop plots. Similarly, men have lost traditional

social and ritual rights but have gained income through cash crop production and wage employment. In this group, resources may be available for the adoption of improved maize, and the willingness of men in this group to invest in agriculture is promising. The third group is composed of large landowners who enjoy the greatest benefits of development efforts. In this group, women have lost their decision-making roles but have gained social power, status, and economic security within the community. Men have greatly expanded their decision-making power both within and beyond the local area. Farmers within this group are typically "modern farmers" who are wealthy enough to adopt and realize the benefits of new agricultural technology.

Koopman, J. 1991. Neoclassical household models and modes of household production: Problems in the analysis of African agricultural households. *Review of Radical Political Economics* 23(3, 4): 148–73.

The models of agricultural households as unified production and consumption units are fundamentally misspecified for Africa. In particular, the assumptions of shared preferences and of pooled incomes and resources are misrepresentative. Instead, in southern Cameroon, the adults of the household conduct separate enterprises, earn individual incomes, and manage separate budgets. The agricultural household models do not recognize that a farmer's access to the resources, productive services, and markets affected by state policy varies significantly according to his or her social position within the household. This paper makes no mention of the relations surrounding maize production (it mentions cocoyam and cocoa production), but it provides useful insights for analysis of intrahousehold issues.

Koopman, J. 1993. The hidden roots of the African food problem: Looking within the rural household. In N. Folbre, B. Bergmann, B. Agarwal, and M. Floro (eds.), *Women's Work in the World Economy.* New York: New York University Press. Pp. 82–103.

This paper examines the contribution of women farmers to household food security and stresses the need for gender-specific analysis of food production constraints. It attributes the decline of Africa's traditional agricultural sector to policies and institutional constraints that neglect the resource needs of women food farmers. In most African smallholder economies, men's and women's agricultural enterprises and incomes remain separate. This impacts the food sector and makes standard agricultural household models fundamentally misspecified. Despite serious economic and social constraints, African women remain highly motivated to increase food production as demonstrated in a case study of maize farmers in Malawi. This paper demonstrates how intrahousehold differences in resources, constraints, and decision-making power impact the issue of food security and technological adoption in sub-Saharan Africa.

Koopman Henn, J. 1983. Feeding the cities and feeding the peasants: What role for Africa's women farmers? *World Development* 11(12): 1043–55.

In the farming systems of the Beti peoples of southern Cameroon and of the Haya of northwestern Tanzania, women and men face different access to land and labor. Since women work more hours than men, increasing the productivity of women is essential. However, as women's productivity increases and their incomes rise, husbands may simply make their wives responsible for more family expenses. Women with access to food markets produce three times as much food as women in similar economic situations where surplus produce can not readily be sold. Women farmers' efforts to enter the cash economy are frustrated by a lack of marketing facilities and modern production inputs and by traditional patriarchal systems that limit women's control of cash incomes, their access to land, and control over their own labor. In the long run, the author favors policies specifically designed to free women of economic subordination. In the short run, the author stresses that many policies can disadvantage women, and, at the very least, attention should be paid to the possible impacts of policies upon women.

Kranz, J., and K. Fiege. 1983. The work never ends: Problems of women in the farm economy of the Ivory Coast. *Development and Cooperation* 6: 12–13.

This article provides a very general description of the social status of women in the Ivory Coast. Increased investment in cash crops has undermined women's ability to provide enough food for themselves and their families. The sexual division of labor is quite fluid; women engage in harvest activities, transport, farm work, and even clear fields. Women are sometimes paid in cash or cloth for work on their husband's export crops, but this cash is almost immediately reinvested in the household. The relaxation of the gender division of labor has increased the burden of rural women. While women have assumed many "male" tasks, men have not taken on tasks traditionally performed by women. Marriage is viewed as undesirable and many women leave their husbands to return to their natal villages. Because marriages are precarious, many women hesitate to invest in land.

Kumar, S.K. 1987. Women's role and agricultural technology. In J.W. Mellor, C.L. Delgado, and M.J. Blackie (eds.), *Accelerating Food Production in Sub-Saharan Africa.* Baltimore, Maryland: Johns Hopkins University Press. Pp. 135–47.

This chapter provides an excellent overview of the issues concerning the adoption of agricultural technology by women. The author suggests that it is important to develop technology packages that address women's labor constraints and ensure them access to the given technology.

Kumar, S.K. 1991. *Adoption of Hybrid Maize in Zambia: Effects on Gender Roles, Food Consumption, and Nutrition.* Research Report 100. Washington, D.C.: IFPRI.

This publication reports on one of the few studies that specifically examines the welfare effects of the adoption of hybrid maize at a household and intrahousehold level. It examines the farm household-level factors that influence the adoption of hybrid maize and the use of fertilizer, and the impacts of the adoption of hybrid maize on food consumption and children's nutrition. The author concludes that policies that support women's participation in making decisions and producing improved grain varieties could improve efficiency, household food consumption, and children's nutrition.

Kumwenda, J.D.T., S.R. Waddington, S.S. Snapp, R.B. Jones, and M.J. Blackie. 1996. *Soil Fertility Management Research for the Maize Cropping Systems of Smallholders in Southern Africa: A Review.* NRG 96-02. Mexico, D.F.: CIMMYT.

Increased population and pressure on available land have led to a decrease in traditional fallowing practices. In many areas of southern Africa, maize is now cropped continuously. The present challenge of improving productivity without compromising sustainability is so great that farmers will need to combine gains from improved germplasm with complementary improvements in soil fertility. Farmers face many constraints to improving soil fertility. Inorganic fertilizer is expensive and households are cash-constrained. Organic sources of nutrients, such as legumes, may be useful, but the potential of these technologies is rarely realized on farmers' fields. In this paper, a model for soil fertility research and extension is developed, which includes the use of both organic and inorganic sources of nutrients and involves the active participation of farmers in improving soil fertility. Although the authors clearly acknowledge that women may be the farmers and decision-makers in smallholder farms, no specific attention is paid to the different constraints that may face male and female farmers.

Ladipo, P. 1991. Looking beyond the farm for gender issues in FSRE. *Journal for Farming Systems Research Extension* 2(2): 39–49.

Based on studies of a maize project in 10 Yoruba villages near Ile-Ife, Nigeria, this paper examines gender issues in the maize system. The author concludes that program interventions at any point in the food system result in changes along all other points. In particular, gender issues in post-harvest processes may affect production. This paper proposes an approach to include all members in the community in the processes of research and extension to anticipate gender issues.

Lado, C. 1992. Female labour participation in agricultural production and the implications for nutrition and health in rural Africa. *Social Science and Medicine* 34(7): 789–807.

This paper examines the effect of colonial practices regarding land and labor on food production in Africa. The authors note the potential impacts of policy changes on health and nutrition as these affect women's incomes and workloads. In addition, they emphasize the interaction between health and agricultural productivity. This article is fairly general, spanning both time and the continent, but it makes some useful points about the potential relationships among women's agricultural labor, health, and nutrition.

Lassiter, G. 1981. *Cropping Enterprises in Eastern Upper Volta.* Washington, D.C.: Department of Agricultural Economics, USAID.

This report provides data on six of the major cropping enterprises used in Burkina Faso during the 1978/79 agricultural year based on a farm-level survey of 480 households. An overview of the 1978 season describes the major characteristics of agriculture in Burkina Faso and attempts to form a historical perspective. Unfortunately, the lack of background data on yields, soils, and rainfall makes economic analysis of a single season extremely difficult. Detailed crop enterprise budgets are provided for six crops in each survey zone. The budgets reveal the low productivity of agriculture in Burkina Faso, especially for cotton and groundnut. Although maize and soybean have higher productivity, production is limited. Maize is an important crop during the "hungry period," but it provides little marketable surplus. Soybean production is constrained by the limited marketing opportunities. Rice production showed the highest returns. Although expansion of rice production would not be difficult technically, rice production is constrained by the lack of an outside market and low local demand. Yields of sorghum/millet are low and unstable due to rainfall variability. The author concludes that technology development efforts should be aimed at sorghum and millet.

Levi, J. 1987. Time, money and food: Household economics and African agriculture. *Africa* 57(3): 377–83.

This article is a review of Alan Low's book, *Agricultural Development in Southern Africa: Farm Household Economics and the Food Crisis*. Although the review is favorable, the reviewer notes that the household models that focus on the allocation of time miss an important point. Time spent working does not have a constant incremental subjective cost. People do not simply want to save time in agricultural production, but they want to save the time that is most costly. The value of a unit of time varies by season and by activity.

Low, A. 1986. *Agricultural Development in Southern Africa: Farm Household Economics and the Food Crisis.* Portsmouth, New Hampshire: Heinemann.

The new household economics models, incorporating both consumption and home and market production, are adapted to the southern African context and used to explain agricultural decisions. In these models, time, rather than money, is the important constraint. Examples drawn from Botswana, Lesotho, and Swaziland provide insights into how households make decisions across different activities. The author suggests that cash crops are grown only when their value exceeds the retail price of food crops and the potential wage employment of the better-qualified household members. This framework explains why hybrid maize in Swaziland was adopted only in areas where wage opportunities were good, rather than in poorer areas.

Low, A. 1988. Farm household-economics and the design and impact of biological research in Southern Africa. *Agriculture Administration and Extension* 29: 23–34.

The use of a farm household perspective is important to understanding African farmers' behavior. Labor, not land, is the most important constraint. This paper notes that there does not have to be a shortage of land for urban migration to occur. Rural outmigration may occur before the marginal returns to labor on the farm begin to fall. Thus, migration may have serious impacts on the labor available within the farm household. The constraints faced by women farmers are also noted. Not only are women often the ones remaining on the farm, but they often have other time-consuming responsibilities, including household tasks and child rearing. These factors have implications for the development of technology. Farm households are concerned about the time use of household members and are interested in minimizing the full cost of producing a unit of output.

Mbata, J.N., and C.J. Amadi. 1993. The role of women in traditional agriculture: A case study of women in food crops production in Rivers State, Nigeria. *Discovery and Innovation* 5(1): 81–87.

This paper documents some of the roles of women in agriculture in Rivers State, Nigeria. In addition, it uses farm budgets and estimates production functions to recommend changes in agricultural activities. The authors conclude that women in the study area were inefficient in the use of all the factors of production. The marginal value products of hired labor, farm size, and seeds were higher than their opportunity costs, while the marginal value product of family labor was lower than its opportunity cost. The reasons why this is so are briefly explored; they include the traditional land tenure system, the low level of education, inadequate capital, and weak extension links.

McHugh, D. 1993. The effect of storage loss rates on the valuation of maize stored traditionally by farmers and removed periodically for food, feed, or sale in Cameroon. *Journal for Farming Systems Research-Extension* 3(2): 13–24.

While the taste and cooking characteristics of new, high-yielding varieties of maize seem to satisfy the farmers of Cameroon, farmers have been slow to adopt the new varieties. The soft, denty grains associated with high yields suffer greater qualitative and quantitative losses under traditional storage conditions than do the small flinty local varieties. Typical partial budget approaches that have been used to evaluate the marginal rate of returns on new varieties fail to take into account non-yield characteristics, price variability throughout the year, and changes in the quality and quantity of grain during storage. This paper develops a model that accounts for these storage losses by assessing the value of maize removed from the store at different times and prevailing prices. It also evaluates the changing qualities of both food and feed maize over the storage season. Maize destined for human consumption is of higher quality (but of the same variety) than feed maize for animals. Over the course of the year, the quality standards for determining which maize is food maize and which is feed maize diminish as both the quality and quantity of stores decrease. An example shows how yield gains from a higher-yielding variety could be outweighed by the poor storage characteristics of improved maize varieties. Breeders should focus on producing hybrid varieties with good storage characteristics.

McMillan, D. 1987. Monitoring the evolution of household economic systems over time in farming systems research. *Development and Change* 18(2): 295–314.

The Volta Valley Authority program is a planned settlement scheme involving agricultural extension for settlers moving into river basins. A case study approach was used to gather information on the evolution of patterns of household and intrahousehold production and consumption. These results were compared with information collected using a farm monitoring survey. The case study provided detailed information not available in the survey, including information about the settlers' economic activities outside the scope of the settlement scheme, both market and non-market flows of goods among households, and the economic activities of many members of the household.

McSweeney, B.G. Collection and analysis of data on rural women's time use. *Studies in Family Planning* 10(11/12): 379–83.

Based on a small sample from Burkina Faso, this study examines detailed time use data for women. A comparison of information on rural women's time use in Burkina Faso yielded by the recall technique and by direct observation showed that about 44% of women's work was unaccounted

for using recall. In addition, although grinding and processing are very time-intensive, the introduction of mills did not always serve to decrease women's labor time. Instead, the mills were used when otherwise a meal would have been foregone. Thus the mills may have increased nutrition, but did not necessarily reduce women's time spent preparing meals.

Mehra, R. 1991. Can structural adjustment work for women farmers? *American Journal of Agricultural Economics.* Pp. 1440–47.

This review of the literature on structural adjustment's impact on the agricultural sector focuses on the ways in which structural adjustment programs may specifically disadvantage women. These programs tend to expand the output of export crops at the expense of food production. Women are more involved in growing food crops. Women, who are overrepresented among small-scale and resource-poor farmers, have limited access to credit, land, agricultural extension and information, and education. In addition, women face heavier time constraints than men. By disregarding the structural constraints facing women farmers, these programs have both disadvantaged women and reduced the effectiveness of the programs.

Moock, P.R. 1976. The efficiency of women as farm managers: Kenya. *American Journal of Agricultural Economics* 55(5): 831–35.

This article investigates the differences in production knowledge between men and women small-scale maize farmers in Kenya. In the Vihiga region of Kenya, 38% of the farms are managed by women. Moock examines the impact of physical inputs and natural factors (including area planted, plant population per acre, labor input per acre, the use of chemical fertilizer or maize hybrids, and variables dealing with the condition of the soil and crops) and information proxy variables (such as sex of manager, years of schooling, migration, age, extension contact, and special extension services accompanied by a loan) upon yield. His results indicate that the impact of schooling on yields is greater for women than for men. Men who have had just a few years of schooling, however, perform worse on efficiency criterion than men who have never attended school. Extension services result in higher yields for men, but not for women. This might be explained by the male orientation of services and staff of Kenya's Ministry of Agriculture.

Moock, J.L. (ed.). 1986. *Understanding Africa's Rural Households and Farming Systems.* Boulder, Colorado: Westview Press.

The articles in this collection discuss the need to examine the relationships between farming systems research and studies of household decision-making in order to improve food production in Africa. The articles make it clear that the conventional norm of a coordinated household unit making unified production and consumption decisions is inappropriate. Instead, there are overlapping management units and a high level of individualized decision-making in many African settings. In addition, the articles note that gender is a key mediating factor, especially in labor relations and other forms of exchange.

Muchena, O.N. 1994. The changing perceptions of women in agriculture. In M. Rukuni and C.K. Eicher (eds.), *Zimbabwe's Agricultural Revolution.* Harare, Zimbabwe: University of Zimbabwe Press.

Women in Zimbabwe have been the primary food producers since before colonialism. Despite the outmigration of men, women's decision-making roles and visibility have not improved substantially. However, some changes have occurred. Increasing awareness of women's input to agricultural production has led to their inclusion in extension groups. In addition, women can now sell produce directly to the Grain Marketing Board. This article is a fairly general description of the role of women in Zimbabwe's agriculture.

Mukumbu, M., and T.S. Jayne. 1995. *Urban Maize Meal Consumption Patterns—Strategies for Improving Food Access for Vulnerable Urban Households in Kenya.* Technical Paper 8. Washington D.C.: USAID Office of Sustainable Development, Bureau for Africa.

This paper challenges the popular belief that consumers prefer refined (sifted) maize flour to the unrefined form, known as *posho*, and that consumers are not influenced by price. The findings from a survey of 350 households in Nairobi, Kenya show that some households in all income quintiles purchase each type of maize meal. Consumption of *posho* is negatively related to household income, while consumption of refined meal increases with income. Convenience (i.e., women's time spent acquiring posho and having it milled, and proximity of the house to the mill) influences demand for posho. The difference in taste between the two types of meal was not a critical factor. Consumer choices have been influenced by policies designed to keep maize prices and supplies stable between 1955 and 1980. The food security of low-income consumers may benefit more from lifting subsidies on refined flour and making posho mills more accessible. This would make it less costly for low-income consumers to buy posho meal. Policies regarding maize must take into consideration that consumer preferences can be endogenous rather than exogenous.

Mungate, D. 1983. Women: The silent farm managers in the small-scale commercial areas of Zimbabwe. *Zimbabwe Agricultural Journal* 80(6): 245–49.

This is one of the early articles emphasizing the importance of including women as clients of the extension service. In particular, it stresses the importance of including the wives of the male farmers who have traditionally been approached by

extension workers. In Zimbabwe, women own 70–80% of the cattle, hence any programs that address livestock, especially the sale of livestock for cash to invest in other aspects of farming, must include women to be successful.

Mwangi, W. 1996. *Low Use of Fertilizer and Low Productivity in Sub-Saharan Africa.* NRG Paper 96-05. Mexico, D.F.: CIMMYT.

Increasing food production in Africa will require intensive agriculture based on modern technologies, including fertilizer. Currently, fertilizer use is low in sub-Saharan Africa. In the short and medium run, the author claims that fertilizer subsidies should be continued. During this period, policy needs to concentrate on developing credit for farmers and private traders; improving infrastructure, especially rural and feeder roads; and increasing research on input-responsive high-yielding varieties, and crop and resource management strategies.

Neitzert, M. 1994. A woman's place: Household labour allocation in rural Kenya. *Canadian Journal of Development Studies* 15(3): 401–27.

Rural women in Kenya specialize in domestic activities rather than wage labor activities. This specialization, combined with discriminatory labor market practices, reduces the market value of women's contribution to the household. This is true for both household and agricultural production activities. The result is that women are less able to take advantage of new economic opportunities in Kenya and resources become inequitably distributed between men and women. These inequities are perpetuated across generations.

Niles, K.D. 1996. *Pinpointing production constraints faced by female-headed households in rural Malawi.* MSc thesis. Agricultural and Applied Economics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Production functions are estimated for three categories of smallholders in Malawi: male-headed households, *de facto* female-headed households, and *de jure* female-headed households. Deviation from profit-maximizing input use does not depend on the gender of the household head. Smallholders who use fertilizer apply profit-maximizing quantities on plots of hybrid and local maize. In addition, more than the profit-maximizing quantity of labor is used on all plots. *De jure* female-headed households growing local maize with fertilizer and hybrid maize without fertilizer are less technically efficient than other smallholder households. However, allocative efficiency does not depend on gender.

Nindi, B.C. 1992. Gender, exploitation development and agricultural transformation in sub-Saharan Africa. *Eastern Africa Economic Review* 8(2): 123–34.

In the short run, it is necessary to direct policies at women if agricultural production in Africa is to increase. Although some argue that women farmers will be a less important part of the agricultural landscape in the long run because they will be displaced through the intensification of agricultural production, this paper argues that the rate of displacement of women farmers will be extremely uneven within and between countries. Thus, in some areas, it will be important to focus on women farmers, even in the long run.

O'Kelly, E. 1955. Corn mill societies in the Southern Cameroons. *African Women* 1: 33–35.

This article describes the plight of women farmers in Cameroon in the 1950s and the initiation of "corn mill societies." Noting that grinding maize, the principal grain, was a time-consuming process for women, the Education Department purchased 15 corn mills. Small sums of money were given to interested communities to erect a hut for the machines. Women gained access to the society by paying a penny to one of two "head women." The money was saved and used to purchase the mill from the Education Department, which used the money to purchase a mill for another community. The plan was initiated in the hopes that once women learned to work together, it would be easier to implement other reforms such as bringing farms closer together, fencing property, and disseminating information to women on topics such as child welfare and sanitation. As the societies' power became recognized, the Education Department hoped that men would consult the society before making decisions affecting women. This paper provides an interesting historical perspective on policies directed at women.

Oboler, R.S. 1985. *Women, Power and Economic Change.* Stanford, California: Stanford University Press.

Based on work among the Nandi in Kenya, the author examines the impact of socioeconomic change on sex roles. Agricultural production and the changing roles and responsibilities for men and women are discussed in detail. Men and women were asked about who was responsible for different activities and which activities were forbidden based on gender. In addition, individuals were asked which activities they were involved with. Much of the text focuses on how the sex roles, including access to land, are contested and changing.

Okeyo, A.P. 1979. Women in the household economy: Managing multiple roles. *Studies in Family Planning* 10(11/12): 337–43.

This study focuses on Luo market women's activities in western Kenya. Market women form cooperative groups that help them perform their family responsibilities, including subsistence production, income generation, child rearing, and household maintenance. The income-generating role of market women receives the most focus, as it is essential to their success in their other responsibilities. This study is most useful for its discussion of how women have coordinated to meet their growing need for cash income.

Olmstead, J. Farmer's wife, weaver's wife: Women and work in two Southern Ethiopian communities. *African Studies Review* 18(3): 85–98.

This article compares the economic status of women in two communities in the Gamu Highlands of Southern Ethiopia. Dita, predominately a farming community, has little contact with neighboring markets. In contrast, Dorze is a weaving community from which men often migrate to sell their goods in more favorable urban markets. The division of labor by sex is more rigid in the weaving community than the farming community. Some agricultural tasks are shared by men and women, but weaving is exclusively a male activity. Despite this inflexibility, women in Dorze have a higher standard of living than those in Dita. In Dorze, women are free to pursue entrepreneurial activities and engage in production for use value, exchange value, or trade. In Dita, by contrast, women are limited to subsistence activities and produce for use value alone, while men engage in trading. In both communities, men wield significantly more economic power than women. The sexual division of labor is less important as an indicator of well-being than the ability of women to earn cash incomes.

Ongaro, W.A. 1990. Modern maize technology, yield variations and efficiency differentials: A case of small farms in Western Kenya. *Eastern Africa Economic Review* 6(1): 11–30.

This article examines the results from a 1983/84 field study in the Kisii and Nandi districts of western Kenya and evaluates the factors that influence maize yield variations and efficiency differentials among small-scale farmers. The Kisii and Nandi districts are maize surplus areas that are targeted for extension services. Access to credit, extension contact, and, in some cases, off-farm work all have a positive and significant effect on maize production. Marginal revenue products for fertilizer are calculated to be twice the input price, implying that nitrogen and phosphate fertilizers are underutilized. While the cost of new maize seed may be minimal, the cost of complementary inputs such as fertilizer may be prohibitive. The author calls for policies that grant credit for inputs and security if crops fail due to adverse weather. This could increase fertilizer use and increase productivity substantially. Significant differences were found in the way male-headed farms and female-headed farms allocate their resources in maize production.

Page, S.L., and P. Chonyera. 1994. The promotion of maize fertilizer packages: A cause of household food insecurity and peasant impoverishment in high rainfall areas of Zimbabwe. *Development Southern Africa* 11(3): 301–20.

This article examines how following recommended practices for maize production affects food security and the household economy. A survey of farmers and extension workers in four of Zimbabwe's communal areas revealed that only one-third of communal farmers had applied fertilizer at the officially recommended rate to their 1990/91 maize crop. Often these farmers obtained their inputs on credit. The majority of farmers had deviated from recommended practices by substituting manure for part or all of the recommended fertilizer application. In three of the four areas studied, this practice improved the chances of recovering input costs and achieving maize self-sufficiency. This article points to the need for less costly maize farming packages and for the integrated use of manure. Although the article notes that most of the farmers interviewed were women, no further discussion of gender is included.

Pala, A.O. 1983. Women's access to land and their role in agriculture and decision-making on the farm: Experiences of the Joluo of Kenya. *Journal of Eastern African Research and Development* 13: 69–85.

Women in the Luo society of Kenya have traditionally been assured usufructuary rights to cultivation plots through the male patrilineage. Men have held allocation rights while women have been responsible for making production decisions. Land tenure changes threaten to erode women's control over "their land" and their ability to provide food for themselves and their children. Presently, 95% of Luo women engage in subsistence agriculture for home consumption. They may also engage in agriculture to raise cash to finance household purchases. Since women have traditionally made production decisions, significant changes in their access to land could alter the production patterns of maize and hybrid maize adoption constraints. The nature of these changes would depend upon the preferences of the new decision-makers, who would probably be men. It is unclear how women's access to land will be protected now that their land can be sold without their consent.

Panin, A. 1988. *Hoe and Bullock Farming Systems in Northern Ghana: A Comparative Socio-Economic Analysis.* Nyankpala Agricultural Research Report 1. Tamale, Ghana: Nyankpala Agricultural Experiment Station.

This study examines the effects of adopting bullock farming systems in northern Ghana, where maize is a major crop. Bullock farmers are generally better equipped with land, family labor capacity, and livestock than are hoe farmers. Adoption of bullock technology generally leads to an increase in area of land cultivated, higher crop yields, higher disposable income and production costs, and some shift from food crops to cash crops. Labor input patterns are very different for hoe and bullock farm households. Male and female children and adult women spend less time in farm work on bullock farms than on hoe farms, but the labor requirements for adult men and elderly men and women are higher on bullock farms than on hoe farms. This study suggests that bullock farming allows for significant yield and net income increases while decreasing the labor burden of adult women by improving factor productivity. Since cash and credit constraints limit the adoption of bullock technology, this study calls for an increased government subsidy to realize these potential yield increases.

Pankhurst, D. 1991. Constraints and incentives in 'successful' Zimbabwean peasant agriculture: The interaction between gender and class. *Journal of Southern African Studies* 17(4): 611–32.

Social differentiation among households in Zimbabwe is analyzed. Four categories of households are delineated: those with significant remittances and more than four acres of land, cattle, a garden, a plow and scotch cart, that employ nonhousehold labor; those with remittances and at least one of the above; those with no remittances but at least one adult male present; and those with no remittances and no adult male present. This paper provides insights into which factors may affect the social differentiation of households and how they may respond to different incentives.

Peter, G., and A. Runge-Metzger. 1993. Monocropping, intercropping or crop rotation? An economic case study from the West African Guinea Savannah with special reference to risk. *Agricultural Systems* 45: 123–43.

This article addresses the question of which cropping system is superior in the West African Guinea Savannah. The most important indicators of success are productivity, stability, and sustainability. A framework for assessing the performance of systems is provided. The experimental data, based on five-year crop sequence trials, are used to conduct an *ex-ante* analysis from a farming systems perspective of 18 farm households. Crop rotation seems to be superior in terms of productivity, profitability, and risk. However, this system provides less flexibility than does traditional intercropping systems. As flexibility is often essential to success in the Guinea Savannah zone, partial adoption of crop rotation seems to be preferable to either crop rotation or traditional intercropping systems alone.

Pingali, P., Y. Bigot, and H.P. Binswanger. 1987. *Agricultural Mechanization and the Evolution of Farming Systems in Sub-Saharan Africa*. Baltimore, Maryland: World Bank, Johns Hopkins University Press.

In this book, the authors explore the puzzle of why mechanization has been slow in Africa, particularly given the abundance of land. While they note that animal traction has spread rapidly in some areas, other areas continue to use the hand hoe. The details in the book will be useful for people interested in questions of when farmers change from hand hoe technologies. The authors conclude that African farmers respond to increasing population density and increased demand for agricultural output by expanding the area under cultivation, increasing investments in land, and adopting new technologies, including animal traction and mechanization. The main reason for the nonadoption of mechanization and animal traction is that it is not cost-effective.

Pittin, R. 1984. Documentation and analysis of the invisible women: A Nigerian case-study. *International Labour Review* 123(4): 473-90.

Because of their seclusion, Hausa women do not participate in agricultural activity. However, they engage in considerable income-generating activity, including trade. This article emphasizes how the contributions of Hausa women are undercalculated because their work is not visible. Women's income-generating activities include the trade and sale of food items, and these activities are facilitated by their children, who bring the goods to market and hawk the wares. A man is expected to pay for food prepared for sale by his wife and a woman may purchase crops from her husband's farm that she needs for her business activities.

Potash, B. 1981. Female farmers, mothers-in-law and extension agents: Development planning and a rural Luo community in Kenya. In R.S. Gallin and A. Spring (eds.), *Women Creating Wealth: Transforming Economic Development.* Washington, D.C.: Association for Women in Development.

Since most development efforts do not occur through formal development projects, this paper examines the impact of agricultural extension agents and community development officers on the activities and welfare of Luo women farmers in Kenya. Extension policies were not adapted for local conditions. In particular, women do almost all of the farming, yet agricultural information was passed to men. A new wife farms for several years under the supervision of her mother-in-law, thus it is critical for extension programs to reach older women. Programs through schools may have a limited effect due to the length of time between the time a girl is in school and the time she farms on her own. Due to the scarcity of land in the area, policies that encourage men to become more involved in agriculture, especially cash cropping, will have a negative effect on women's access to land.

Quisumbing, A.R. 1995. *Gender Differences in Agricultural Productivity: A Survey of Empirical Evidence.* Washington, D.C.: Food Consumption and Nutrition Division, IFPRI.

This review article examines the econometric evidence on gender differences in agricultural productivity. It finds that, in general, female and male farmers are equally efficient as farm managers and that productivity differences are attributable to female farmers' lower use of inputs and lower levels of human capital. The paper provides a critique of the methodologies used in these studies.

Randolph, S. 1988. Constraints to agricultural production in Africa: A survey of female farmers in the Ruhengeri Prefecture of Rwanda. *Studies in Comparative International Development* 23: 78–98.

This paper examines the causes of the intensification of agriculture. Traditionally, it has been thought that when population pressures increase, peasant farms restructure themselves and adapt by reducing population growth, intensifying use of existing land and/or expanding the resource base. In contrast, this paper argues that such restructuring or adaptation may not occur without successful policy initiatives. A 1986 farming system survey of women farmers in Rwanda is the basis for describing the organization and method of operation of agricultural household, with particular attention paid to production constraints and demographic information. This information is used to demonstrate the importance of women farmers to agriculture and to argue for policies that consider women's needs when addressing agricultural issues. This paper presents the first data gathered on rural farm women in Rwanda and is most interesting for its implications on adaptation to population growth and demographic pressures. The staples of the region include beans, sorghum, sweet potatoes, manioc, peas, and, to a lesser extent, maize. If the pressures associated with population pressure reduce, rather than enhance, farmers' ability to intensify, then the adoption of hybrid varieties of maize or other purchased inputs is likely to be hindered.

Reardon, T. 1997. Using evidence of household income diversification to inform study of the rural nonfarm labor market in Africa. *World Development* 25(5): 735–47.

Reviewing 23 field studies in Africa, the author finds that non-farm wage labor, non-farm sector earnings, and local non-farm earnings are important sources of income for rural households. Self-employment, farm sector wage earnings, and migration earnings were less important. However, the distribution of these earnings is quite inequitable, suggesting that there are barriers to entry and market segmentation. The author notes a need for more work on how policy and agricultural technology changes affect the rural nonfarm sector, if we are to understand rural poverty and develop appropriate responses.

Roberts, P. 1988. Rural women's access to labor in West Africa. In S. Stichter and J. Parpart (eds.), *Patriarchy and Class: African Women in the Home and Workplace*.

The biggest constraint to agricultural production in Africa is the shortage of labor. Since women farmers are even more disadvantaged than their male counterparts in recruiting labor, they have devised somewhat different approaches to farming. The author explores the circumstances under which women recruit labor and who they recruit. The established view has been that women either work for others or work single-handedly for themselves. However, there is evidence that these characteristics of women's farming may result from women's low access to labor, not from the constraints of child-bearing and child care duties. Women's lack of social power in the household hierarchy makes it difficult for them to demand labor from others as men are able to do. Furthermore, women experience different pressures and constraints than men: they are obligated to contribute financially to the household. But since a woman must also contribute labor on her husband's land, with no reciprocal claim on her husband's labor, this limits the labor that she has available for generating an income through own-account enterprises. The author hypothesizes that in the past, women's enterprises were larger because slave labor was available. When this was abolished, women's freedoms were constrained because they either became the main labor source in the male farming systems or the sole producers in female systems.

Rohrbach, D.D. 1989. *The Economics of Smallholder Maize Production in Zimbabwe: Implications for Food Security.* East Lansing, Michigan: Michigan State University.

This report examines the rapid growth of maize production in Zimbabwe between 1977 and 1985. The most important causes of this growth were the ending of the war for independence, the expansion of product markets, smallholder credit and input markets, strong research and extension support, and the maintenance of favorable producer prices. Although increased maize production benefited smallholder farmers in rural areas, these gains were not evenly distributed. A comparison of maize production, input adoption, and food security in the communal areas of Mangwende and Chivi reveal that better endowed farmers in high-rainfall zones benefited most from post-independence policies. Despite the aggregate growth in maize production and national food security, large portions of the smallholder population still face consumption and production deficits. This paper does not mention gender or how the increase in maize production has influenced women particularly.

Rukuni, M., and C.K. Eicher (eds.). 1994. *Zimbabwe's Agricultural Revolution.* Harare, Zimbabwe: University of Zimbabwe Press.

Zimbabwe has been relatively successful in promoting increased agricultural production, especially among smallholder farmers. This book explores the many aspects of Zimbabwe's agricultural revolution. Chapters by different authors discuss the relevant factors, including infrastructure and institutions. In addition, the welfare impacts and the reasons for ongoing food insecurity among some Zimbabweans is analyzed. (Also see annotation for chapter on gender issues by Muchena.)

Runge-Metzger, A. 1988. *Variability in Agronomic Practices and Allocative Efficiency Among Farm Households in Northern Ghana: A Case Study of On Farm Research.* Agricultural Research Report 2. Tamale, Ghana,: Nyankpala Agricultural Experiment Station.

This research report sets forth a bottom-up theoretical framework of data collection and analysis pertaining to allocative efficiency in northern Ghana. The data were collected in 1984, a year with good rainfall. As a result, many of the findings may overstate the actual efficiency of different techniques. The study examines the yields of different cropping systems, including maize-sorghum-groundnut combinations, and rates their marginal returns. The study defines allocative efficiency as meeting the nutritional needs of the household and concludes that the age of the household head and the number of male household members per hectare of land will affect allocative efficiency.

Runge-Metzger, A., and L. Diehl. 1993. *Farm Household Systems in Northern Ghana.* Agricultural Research Report 9. Nyankpala Agricultural Research Station, Tamale, Ghana,: Nyankpala Agricultural Experiment Station.

This case study in farming systems research provides a detailed description of farm household systems in northern Ghana. The first two sections evaluate the farming systems approach to agricultural research in agricultural. The following sections describe the farm household systems and the driving forces for their differentiation, including demographic characteristics (number of consumers and labor capacity) and resource endowments (land, capital). Information on agricultural land use such as cropping patterns, soil preparation, harvesting, weeding, fertilization, and physical yields of plant production is provided. Two case studies examine time allocation between farm and household activities and demonstrate the seasonal distribution of farm labor and gender-specificity of labor inputs. This report contains a substantial amount of data on maize production in Ghana and on the gendered contributions to labor within the household economy.

Russell, D. 1988. *The Integration of Women as Farmer Leaders in the Central Shaba Project.* Zaire, USAID. Mimeo.

This report evaluates an extension program in Central Shaba, Zaire. The program called for women and men to serve as farmer leaders who would be instructed about new seeds and farming techniques; however, there was concern over the actual level of participation of women in the project. Women's involvement varies considerably across regions in Central Shaba, although maize is typically a men's crop and a cash crop. The authors first identified characteristics of communities that have the highest potential for raising women's involvement, including a good reputation of the project extension agent within the community, a community authority willing to help, existing women's organizations, high women's involvement in farming, and permission of the extension agent to work with single and widowed women. The authors also outline some of the support systems available to women in the region, including religious groups. Background on some social constraints is provided, such as women's restricted access to household revenue and the stigma attached to single and widowed women. Since women clearly have a role as farmers, the authors encourage attempts to involve them in the extension program and suggest follow-up contacts, training of new agents, recruitment of women, and more attention to and integration of women's concerns.

Safilios-Rothschild, C. 1985. The persistence of women's invisibility in agriculture: Theoretical and policy lessons from Lesotho and Sierra Leone. *Economic Development and Cultural Change* 33(2): 299–317.

Despite the degree to which women participate in agriculture and income-generating activities, they remain relatively invisible to policymakers and development planners. Within a system of patriarchal values, family labor and family income hide women's participation as agricultural and economic agents. Women are seen as seasonal and auxiliary farm labor. This perception limits their access to credit, inputs, and information. Even in countries such as Lesotho and Sierra Leone, where social situations are favorable to breaking down sex-stratification, institutional constraints have reinforced the status quo. In Sierra Leone, traditions of women's credit and thrift cooperatives exist but have been limited by lack of access to information and inputs. In Lesotho, male outmigration has created large labor shortages. Despite their prominent role in agriculture, women have not been integrated into agricultural development projects. Explanations of the institutional constraints women face are discussed to draw important theoretical and policy conclusions. First, statistics documenting rural women's contributions to agriculture and the large number of *de facto* and legal female-headed households need to be disseminated to local policymakers, agricultural researchers and statisticians, and international agencies and donors. Second, women's interest groups need to become officially registered and eligible for institutional aid. While maize is mentioned only once in this article, the importance of gender impacts is well argued and applicable to all development efforts.

Saito, K.A., and C.J. Weidemann. 1990. *Agricultural Extension for Women Farmers in Africa.* World Bank Discussion Paper 103. Washington, D.C.: World Bank.

This report provides a comprehensive discussion of the need for agricultural extension to reach women farmers. It begins with an analysis of why women farmers need assistance and details the specific barriers that women face. The following

sections provide guidelines for project design and suggestions for project components and interventions. These guidelines suggest that projects should be site specific, small (at least initially), flexible, include the cooperation of men in the community, and incorporate women in the design and evaluation. The author recommends against a separate extension system for women.

Scones, I. 1995. Investigating difference: Applications of wealth ranking and household survey approaches among farming households in Southern Zimbabwe. *Development and Change* 26: 67–88.

This paper reports on a study using village member rankings of the wealth of households to further our understanding of the assets and wealth of village households. The data complement previous survey data related to the wealth and assets of different households. Men and women had different ideas of what constitutes wealth, with women focusing more on cash incomes while men defined wealthier households as those with more livestock and agricultural production.

Seifert, M. 1993. The adoption of animal traction in a West African savannah area—an example of autonomous reactions to population growth. *Quarterly Journal of International Agriculture* 32(3): 280–92.

In response to increasing population growth and the resultant scarcity of land, farmers in northern Ghana are adopting animal traction. This article claims to test and support Boserup's hypothesis about technology. Although it is not specifically about maize, it provides a useful analysis of technology adoption in West Africa. Gender issues are not considered or discussed.

Shumba, E.M. 1986. A comparison of maize and groundnut husbandry practices under communal area production. *The Zimbabwe Journal of Agricultural Research* 83(4): 137–40.

The majority of farmers included in a technology assessment survey in the Mangwende Communal Area in 1984 were increasing the area planted to maize and decreasing groundnut production. This paper compares farmer husbandry practices and production levels of maize and groundnut in order to identify possible research avenues for boosting groundnut production. The major contribution of this paper is its concise description of maize husbandry in the region, including productivity levels, crop varieties available, plant populations, and methods of pest and disease control. No specific mention of women farmers is made. The paper concludes that the higher levels of production and productivity of maize relative to groundnut result from superior husbandry practices that have been adopted by farmers for maize production. Since more resources are being allocated to the inputs and management requirements of maize, groundnut cannot effectively compete. This paper argues that improving current maize husbandry practices further might free resources for improving and expanding groundnut production.

Singh, R.D., and M.J. Morey. 1987. The value of work-at-home and contributions of wives' household service in polygamous families: Evidence from an African LDC. *Economic Development and Cultural Change* 35(4): 743-65.

This paper attempts to estimate the marginal productivity of work-at-home and explores how to establish a value of work-at-home for farm wives in Burkina Faso. Wife's age, number of hours of animal traction used, number of wives, and marginal productivity of wife's time in farm production were all significant variables in explaining marginal productivity in household activities. In particular, the marginal productivity of women's work in agriculture was negatively related to the marginal productivity of women's work in the household. Estimates of the value of wives' work varied significantly with the economic characteristics of the household, yet the estimates clearly demonstrate that women make a significant contribution to household welfare.

Smale, M. 1991. Chimanga Cha Makolo, *Hybrids, and Composites: An Analysis of Farmers' Adoption of Maize Technology in Malawi, 1989–91*. Economics Working Paper 91-04. Mexico, D.F.: CIMMYT.

This report details the factors affecting the adoption of maize technology in Malawi. The authors note that farmers have multiple objectives and constraints. Farmers also have complex adoption patterns involving both the extent and intensity of adoption. Differences in adoption by region are considered. The authors note that female-headed households are less likely to adopt improved technologies and that lack of access to cash is one of the reasons.

Smale, M., R.E. Just, and H.D. Leathers. 1994. Land allocation in HYV adoption models: An investigation of alternative explanations. *American Journal of Agricultural Economics* 76: 535–46.

In Malawi, farmers plant both traditional and high-yielding varieties in their fields. This paper develops a model that incorporates four different reasons for such land allocation patterns. These reasons include the short-run fixity of land, farmers planting a portfolio of crops to minimize exposure to risk, farmers choosing a safety-first approach to ensure the adequate production of maize for household consumption, and experimentation and learning. Although gender is not specifically discussed, this article has relevance for studies of gender, because it emphasizes that a model that incorporates a number of reasons for farmer behavior may better explain farmer behavior than individual models that separately consider different reasons.

Smale, M., and P. Heisey. 1994. Maize research in Malawi revisited: An emerging success story. *Journal of International Development* 6(6): 689–706.

Malawi is emerging as an example of a successful maize research program. The research strategy has emphasized the needs of small-scale farmers and consumers' concern with maize texture. The semiflint hybrids that have been released are adapted to smallholders needs. Sustained success of the program depends on national commitment to developing varieties for smallholders and continued investments in maize research and support for seed production and input distribution systems.

Smale, M., and P. Heisey. 1994. Gendered impacts of fertilizer subsidy removal programs in Malawi and Cameroon. Comment. *Agricultural Economics* 10: 95–99.

This article was written in response to Gladwin's article on fertilizer subsidies (also listed in this bibliography.) The authors suggest that, contrary to Gladwin's assertions, hybrid maize is not an export crop, but both hybrid and local maize varieties are grown by farmers to meet both cash and subsistence needs. In addition, since Gladwin's results compare the situations for male and female heads of households, it is not appropriate to use these results to discuss the effects on women farmers, who may reside in either type of household.

Smale, M. 1995. Maize is life: Malawi's delayed green revolution. *World Development* 23(5): 819–31.

This paper analyses the institutional factors that have affected the maize research and distribution system in Malawi. Minimal effective demand for seed research for smallholder farmers limited the initial development of appropriate varieties. However, farmer organizations have shaped the demand for technical change. Recent successes in maize research have led to the potential for a green revolution to occur among smallholder maize farmers in Malawi.

Smale, M., P. Heisey, and H. Leathers. 1995. Maize of the ancestors and modern varieties: The microeconomics of high-yielding variety adoption in Malawi. *Economic Development and Cultural Change* 43(2): 351–68.

This article examines a model of seed and fertilizer adoption in terms of two simultaneous choices: land allocation to traditional and hybrid maize varieties and application of fertilizer to a traditional variety. Four models were treated here as special cases of a general theoretical model and tested empirically. The four models are as follows: (1) the "safety-first" model, where farmers choose crop allocations that diverge from those associated with profit maximization in order to ensure that their subsistence needs are met; (2) the portfolio selection approach, in which risk-averse farmers who maximize the expected utility of income increase overall mean returns or reduce overall variance of returns by choosing a combination of seed varieties; (3) the dynamic context, in which farmers who value the future utility of information may choose to adopt a technology partially, even when it is currently unprofitable; and (4) joint production of both modern and traditional varieties, which can also occur in agricultural economies where the supply of market inputs or credit is rationed, because inputs normally regarded as variables can be considered as quasi-fixed, allocable inputs in the short-run. The econometric results highlight the interrelationships between the choice of land allocation to modern variety, and fertilizer application to the traditional variety.

Smith, J., A.D. Barau, A. Goldman, and J.H. Mareck. 1994. The role of technology in agricultural intensification: The evolution of maize production in the Northern Guinea Savanna of Nigeria. *Economic Development and Cultural Change* 42(3): 537–54.

Traditional models suggest that agricultural intensification is driven by population growth and improved access to markets. However, intensification of land use can occur rapidly if exogenous changes such as new technologies are introduced. Unlike population-driven intensification, which tends to be gradual, technology-driven intensification can be rapid. The example of maize adoption in northern Nigeria in the early 1980s illustrates this phenomenon. Prior to the introduction of the improved variety TZB by agricultural development projects, maize was an insignificant crop grown in small quantities. By the end of the 1980s, it was a major cash and food crop. Fallow cycles had been replaced by continuous cropping and widespread fertilizer use (100% in some regions). The exogenous factors responsible for these rapid changes were an improved transport system, the introduction of improved maize with favored characteristics (whiteness, good husk cover, significantly higher yields, fertilizer responsiveness), agricultural development projects, and a significant fertilizer subsidy. Although the fertilizer subsidy sometimes led to excess demand, it clearly sped the adoption and expansion of maize. The high rate of subsidy calls into question both the sustainability of intensification and the economic efficiency of the present system.

Spiro. 1985. *The Ilora Farm Settlement in Nigeria.* West Hartford, Connecticut: Kumarian Press.

This case study examines the situation of women in a settlement in southwestern Nigeria in 1977, 18 years after the settlement was founded. The settlement scheme was one of many designed to establish modern, mechanized farm communities to stem rural-urban migration. The settlement has not been particularly successful, and although the case study focuses on the problems facing women in the settlement, men faced many similar problems. Eleven

women (out of 52 households that included women) were involved in own-account farming. They had greater access to extension advice than women in a nearby village. Increased food production by men resulted in women being able to sell a larger portion of their own crops than was typical in the region. Women in the settlement also worked fewer hours than their counterparts in the nearby village. However, the settlement was not linked with markets, making it difficult for women to participate in trading, which was their primary income-generating activity. In addition, women were not given settler status and did not obtain land rights on their own.

Spiro, H.M. 1987. Women farmers and traders in Oyo State, Nigeria—A case study of their changing roles. In J.H. Momsen and J.G. Townsend (eds.), ***Geography of Gender in the Third World*****. Albany, New York: State University of New York Press.**

The economic roles of men and women are examined for two settings in Oyo State, Nigeria: Oluwatedo village, which is a traditional settlement with medium-sized farms, and the Ilora farm settlement, which is a planned settlement with large farms. Land tenancy differs in the two areas, but in general women work on their parents' or husbands' farms and do not own their own land. Most of the men farm and most of the women participate in trade activities. However, regardless of occupation, women spend about 25% of their time on farm work. Women are involved in planting, applying fertilizer, harvesting, transporting, processing, and selling crops; some have recently begun farming on their own. However, women also contribute financially to their families and their own kin groups, primarily through trading and especially through trading prepared food. Despite the popular view that women are mainly traders, all women in the study area did more farm work than trading. The author also points out the overlap in gender roles and states that child-care can be adequately accomplished simultaneously with trading or farming. One implication of these findings is that development policies must recognize women's need for independent incomes in order to be successful.

Spring, A. 1995. ***Agricultural Development and Gender Issues in Malawi.*** **New York: University Press of America.**

The Women in Agricultural Development Project in Malawi in the early 1980s was considered a success and an example for other projects designed to benefit women. The book details the project and the structure of agriculture in Malawi. In addition, it provides gender-disaggregated data on agricultural production in Malawi and a discussion of how to improve data collection to ensure that women and their activities are not underrepresented. A case study focuses on the maize trials in one rural development project. Differences exist in farming systems by wealth and gender, but women were successfully involved in the maize trials and worked well with male extension officers and researchers.

Spurling, D., H. Mekonen, and K.A. Saito. 1994. ***Raising the Productivity of Women Farmers in Sub-Saharan Africa*****. Washington, D.C.: World Bank.**

Although women farmers dominate smallholder food production in Burkina Faso, Kenya, Nigeria, and Zambia, the economic, social, and cultural environment in which they work is inhospitable to increasing productivity. This report documents women's role in agriculture, identifies and evaluates the key constraints women farmers face, and recommends measures to alleviate these constraints. The study finds that rural African households are changing and that traditional gender roles in farming systems are breaking down. As many men migrate off the farm, women are growing crops and performing tasks traditionally reserved for men. Female-headed households are becoming increasingly common and the demands on the time of women who head households are significantly greater than demands placed on men. Many farms headed by women cannot achieve potential agricultural output due to their disadvantaged access to inputs and support services. Steps should be taken to secure women's access to sufficient land, labor, technology appropriate to women's needs, gender-sensitive agricultural research and extension, and credit.

Stamp, P. 1976. Perceptions of change and economic strategy among Kikuyu women of Mitero, Kenya. ***Rural Africana*** **29 (Winter): 19–43.**

This article relates how Kikuyu women perceive the social and economic changes they have experienced in the last 50 years. In the past, the community engaged exclusively in subsistence hoe-agriculture, with maize being one of the staple crops. The introduction of cash crops, such as coffee, has catalyzed the shift to a money economy. Men are primarily responsible for coffee production and all of the benefits accrue to them, even when their wives provide the labor. Women continue to engage in traditional subsistence agriculture, growing maize for their family's consumption. Many women complain that development has weakened feelings of social responsibility and that husbands no longer provide enough support for their families. However, many women welcome the increased independence they have gained through their participation in women's groups, entrepreneurial activities, and new legal rights (such as being able to hold land). Communal women's groups have increased individuals' bargaining power as well as the social and political clout of the group as a whole. These groups grew out of, and eventually replaced, traditional women's lodges. This article provides an account of the ambivalent feelings many women have towards the social and economic changes precipitated by development efforts.

Staudt, K. 1985. *Agricultural Policy Implementation: A Case Study from Western Kenya.* West Hartford, Connecticut: Kumarian Press.

The levels of access of female-managed and jointly managed farms to agricultural services were compared to see whether Kenyan agricultural policy objectives had been met. In 1974/75, a sample of 212 households, 40% with female managers, were surveyed in the Shikulu research area in western Kenya. The outcomes were examined across three administrative settings: Shikulu area, which has had ordinary implementation of services; Shitoli, which has had intensified services; and the Lirhembe Cooperative, which has more intensive or saturate services. Female managers received fewer on-farm visits from extension agents, were less likely to receive formal training, and were less knowledgeable about loans than their male counterparts on jointly managed farms. The gap between female and joint access in these categories narrowed as service intensified, but this came at enormous cost and is also likely to foster increased dependence of farmers on government agencies. Women managers were more likely than joint managers to learn about hybrid maize through second-hand sources, such as neighbors and women's groups. The author speculates whether there might be more efficient and less costly channels through which to aid women farmers. Women managers are better off with only ordinary levels of service, as long as they are able to participate in communal networks. When given adequate support, women managers tend to be more innovative than male managers. The study suggests that administrative inequities (and not other factors such as land scarcity) are a major cause of the decline in the productivity of women farmers.

Staudt, K. 1987. Uncaptured or unmotivated? Women and the food crisis in Africa. *Rural Sociology* 52: 37–55.

There has been a great deal of theorizing about the African food crisis, although much of the academic literature had ignored gender labor relations. This paper discusses a gendered approach to African agriculture. Gender-differentiated labor, incentives, and struggles over access to resources have important implications for development. If women continue to be systematically denied access to resources and the benefits accrued by their additional labor input, they will not have the means or incentives to contribute their labor to increase production. The paper critiques two theoretical approaches designed to explain Africa's development crises. One points to the creation of faulty incentives under statist strategies, while the other focuses on an uncaptured peasantry. Both explanations are undermined by their complete disregard of gender labor relations. The paper concludes with a discussion of policy implications of a gendered approach to agriculture. Maize is mentioned solely as an example of an innovation that was accepted by African women farmers because they expected to be personally rewarded.

Suda, C.A. 1996. *Household Labor Use and Changes in Gender Roles on Small Farms in Ndhiwa Division, Western Kenya: The Challenge of Comparing the Contributions of Different Workers.* Monograph #1. Nairobi, Kenya: Institute of African Studies.

This empirical micro-level study investigates and analyses patterns of labor contributions by male and female farmers engaged in small-scale farm production in Ndhiwa Division, Western Kenya. The primary data were collected by survey and show what percentage of men, women, children, and hired labor perform tasks frequently, occasionally, or never. The data do not show how intensively, either in effort or duration, these tasks are performed by different groups. Agricultural production in the study region relies upon unpaid family labor. Most of the labor for food production and household nurturing is provided by women. Men are more often involved in animal husbandry, although increased migration has led women to adopt tasks such as milking and herding. The division of labor by gender is changing, but in such a way that women are performing a disproportionately large amount of tasks. While off-farm enterprises are often unproductive or unavailable, men are much less likely to engage in tasks traditionally allocated to women than women are to adopt traditionally male tasks. Improvements in infrastructure, policies to relieve women of time constraints, and education to correct "outdated" patriarchal assumptions would benefit both women and the rural community at large. In addition, early maturing maize varieties would help the region by changing seasonal labor demands.

Tripp, R. 1993. Invisible hands, indigenous knowledge and inevitable fads: Challenges to public sector agricultural research in Ghana. *World Development* 21(12): 2003–16.

Support for public sector agricultural research is declining. Although private and NGO involvement in maize research is important in Ghana, there continues to be a need for public sector involvement in research and in the maize sector generally in Ghana.

Tschirley, D.L., and A.P. Santos. 1995. *Who Eats Yellow Maize? Preliminary Results of a Survey of Consumer Maize Preferences in Maputo, Mozambique.* East Lansing, Michigan: Department of Agricultural Economics, Michigan State University.

This study is based on preliminary results from research on consumer maize preferences in low-income barrios of Maputo, Mozambique. Historically, white maize has been used for human consumption while yellow maize has been restricted to animal feed. The world market for white maize is smaller, higher priced, and more volatile than the yellow maize market. Recently, food-aid shipments have made yellow maize available in Mozambique at relatively

low prices. While almost all consumers interviewed preferred white maize, pricing games suggest that low-income consumers are not willing to pay large price premiums for white maize products. At price discounts comparable to world price differentials, one-third of poor-consumers and one-quarter of all consumers will switch to yellow maize. Ready availability of low-cost yellow maize would increase the real purchasing power of the poorest consumers. In addition, at relatively low discounts, poor consumers are willing to substitute whole meals for more refined meals.

Tshibaka, T.B. 1992. *Labor in the Rural Household Economy of the Zairian Basin*. Research Report 94. Washington, D.C.: IFPRI.

Based on a survey of households in the Zairian Basin, a rain forest zone, this research report examines labor issues in the household rural economy. The determinants of labor use and the factors that affect labor productivity are examined. Gender divisions of labor are included in the analysis. The author suggests that households make collective decisions about agricultural production, unlike households in other parts of Africa where men and women may farm more separately. In order to have both growth and equity in this region of the Congo (formerly Zaire), it will be necessary to increase the productivity of labor. The recommendations for the short run include improving research, extension, and weather forecasting abilities to develop a sound agricultural calendar for the area. In the medium term, it will be necessary to improve the basic infrastructure, such as roads and distribution and marketing channels. In the long run, rural capital and credit markets must be developed.

Udry, C., J. Hoddinott, H. Alderman, and L. Haddad. 1995. Gender differentials in farm productivity: Implications for household efficiency and agricultural policy. *Food Policy* 20(5): 407–23.

Using data on Burkina Faso, the authors find that plots controlled by women are farmed much less intensively than similar plots simultaneously planted with the same crop but controlled by men in the same household. This suggests that a key assumption of almost all household models (including the new collective and bargaining models), which is that households achieve Pareto efficient outcomes, may be incorrect. The existence of inefficiencies within households suggests that many resources are neither pooled or traded within households and that missing markets may exist within households as well as within communities and regions. Improvements in credit markets and access to inputs for women would allow them to choose efficient levels of these inputs, regardless of the levels chosen by men for their plots.

Udry, C. 1996. Gender, agricultural production, and the theory of the household. *Journal of Political Economy* 104(5): 1010–46.

Models of household decision-making usually make the assumption that the allocation of resources is Pareto efficient. For agricultural households, this would suggest that factors are allocated efficiently across plots. However, the results of this paper, using household survey data from Burkina Faso, suggest that plots controlled by women are farmed less intensively than those farmed by men. By reallocating resources across plots within the household, total household production could be increased. This suggests that households are not making unified decisions about the allocation of resources.

Vaughan, M. 1985. Household units and historical process in Southern Malawi. *Review of African Political Economy* 34: 35–45.

This paper examines the effects of commodity production on rural households in southern Malawi during the colonial period to analyze how the circumstances under which commodity production is initiated may affect the position of women. Although the case studies are of cotton and tobacco, the broader message may be relevant for understanding maize production. In particular, Vaughn argues that the timing of women entering commodity production is important. If they enter it at the same time as men, they may have more bargaining power to retain their land once land becomes scarce.

von Braun, J., and P. J.R Webb. 1989. The impact of new crop technology on the agricultural division of labor in a West African setting. *Economic Development and Cultural Change* 37(3): 513–34.

Centralized pump irrigation schemes were introduced into the Gambia specifically to address differential gender roles in farming. In this area, rice was traditionally a crop grown on women's individually controlled plots. Women use rice for home consumption and market sales. Upland crops, including maize, were grown on communal plots controlled by men for consumption by the compound. The introduction of the pump schemes resulted in a shift to rice being grown communally on land controlled by the male compound head. Thus, this study explores the relationships between crops, technologies, and control of land to examine how changing technologies affect gender relations. The impact of these shifts on maize production is not examined.

Warner, M.W., and K.B. Warner. 1996. How useful is gender in explaining the economic roles of Africa's rural peoples? In the series on *Empirical Agricultural Economics and Econometrics.* Dept. of Agricultural Economics, Wye College, University of London, London, UK.

Using household survey data from the Dagomba, in northern Ghana, this paper seeks to demonstrate that social constructs in addition to gender are important determinants of individuals' economic roles. Although marital status is not important in explaining men's participation in different men's activities, women's marital status does affect the economic activities in which they engage. In addition, seniority among wives will affect their economic roles, with junior wives more involved in cooking and senior wives more able to be involved with activities outside of the compound.

Warner, M.W., R.M. Al-Hassan, and J.G. Kydd. 1997. Beyond gender roles? Conceptualizing the social and economic lives of rural peoples in Sub-Saharan Africa. *Development and Change* 28(2): 143–68.

Recent approaches to understanding development have often examined men's and women's gender roles, but this level of analysis has not been enough. The authors argue that it is important to consider the roles of men and women of different social standing within a village. Using a case study of the Dagomba in northern Ghana, the researchers identity five categories of social standing for women: retired cooking wives, active cooking wives, junior wives, unmarried women, and divorced women. Women in these different categories have different roles, opportunities, and responsibilities. Development programs need to consider these different roles, in particular to address the labor burdens of junior wives through labor-saving technologies and to expand the opportunities for senior women to contribute through increasing income-generating opportunities.

Watts, M.J. 1983. The political economy of climatic hazards: A village perspective on drought and peasant economy in a semi-arid region of West Africa. *Cahiers d'Etudes Africaines* 23: 37–72.

This paper seeks to explain the problem of food and hunger in drought-prone northern Nigeria. It examines production from a political economy viewpoint that accounts for social inequality and peasant differentiation. Claiming that the roots of contemporary hunger are found in the political economy of colonialism, peasant reactions to drought and risk in the precolonial and colonial periods are examined. Subsistence patterns, such as risk aversion, are modern manifestations of dealing with climatic hazards. Risk aversion is not uniformly distributed among village households; hazard response is contingent upon social status, with the poorest farmers unable to engage in many risk-reducing activities. Maize stores are a source of food security for the hungry period, and all agricultural production is tied to political and social factors. Although gender issues are not discussed, Watt's argument that socially disadvantaged poor farmers may not have the resources to reduce risk can be readily applied to many women farmers. Indeed, a political economy view of hazard response may be useful for considering gender relations within the household.

Watts, S.J. 1984. Rural women as food processors and traders: *Eko*-making in the Ilorin area of Nigeria. *Journal of Developing Areas* 19: 71–82.

Rural women around the area of Ilorin in Nigeria frequently produce *eko*, a maize-meal snack. *Eko*-making is a low-profit, labor-intensive activity. The majority of women producers buy the maize that they use. Some purchase it from their husbands, but they must pay the market rate. During the hungry season, when the cost of maize and other inputs increases, customers are not willing to pay higher prices for *eko* and thus the profit margins are lower. The increased availability of maize at lower prices would benefit these women.

Watts, M. 1991. Entitlements or empowerment? Famine and starvation in Africa. *Review of African Political Economy* 51: 9–26.

This paper reviews recent research on famine in Africa. It argues that the entitlement approach associated with Amartya Sen, while useful for focusing on the specific social, political, and institutional relations between people and food, must be examined within the larger framework of political economy. By exploring how entitlements and endowments are distributed and contested, the idea of entitlements is expanded to include empowerment. The article notes that even within the household, competition exists along gender and generational lines for entitlements. During times of crisis, these struggles may be exacerbated and the household may eventually disintegrate. Hence, gender subordination prior to a crisis can explain why women are neglected, abandoned, divorced, or sold into prostitution during famine to ensure male survival. Entitlements based on gender and their implications for intrahousehold food access and distribution are discussed.

Whitaker, C.N.C. 1996. The impact of women's participation in an income-generation program in southwestern Tanzania. PhD dissertation. Johns Hopkins University, Baltimore, Maryland.

Women's participation in a credit and income-generation project in Tanzania is the focus of this dissertation. One component of the project involved increasing the output of maize for sale. Background information on women's income and women's roles in household decision-making and the changes that occurred as a result of the project are

discussed. Struggles resulted over access to land, labor, and project resources between project staff and beneficiaries and within the households and communities of the beneficiaries. One result of the conflict was to switch the focus to increasing women's productivity for household consumption, rather than for cash sales. The effects of the project depended on women's marital status. Married women in polygamous households received fewer benefits than single or monogamously married women.

Whitehead, A. 1994. Wives and mothers: Female farmers in Africa. In A. Adepoju and C. Oppong (eds.), *Gender, Work and Population in Sub-Saharan Africa*. Portsmouth, New Hampshire: Heinemann.

This article provides an excellent overview of issues of women and farming in Africa. The first section describes the role of women in smallholder production. Then, the author discusses problems with data collection that lead to women being ignored in many national-level statistics. Women's roles in the household are also discussed, in particular the extent to which women's concern for the welfare of their children affect their economic decisions. Finally, the author notes that efforts that increase the visibility of women's work and further understanding of the basis of women's economic decision-making are needed to make appropriate choices for the allocation of scarce resources to Africa's agriculture sectors. Although examples are drawn from numerous countries, they are used to explain when different situations might arise, rather than draw broad conclusions about agriculture in Africa.

Wood, A.P., S.A. Kean, J.T. Milmo, and D.M.Warren (eds.). 1990. *The Dynamics of Agricultural Policy and Reform in Zambia.* Ames, Iowa: Iowa State University Press.

This collection of articles provides a detailed analysis of agricultural policies in Zambia. Five sections include a historical overview, natural resource management, agricultural planning, agricultural services, and market oriented agriculture. Maize is the primary staple crop, and many of the chapters focus on policies relating to maize. In addition, several of the chapters explicitly address issues regarding women farmers in Zambia.

World Bank. 1995. *Rural Women in the Sahel and Their Access to Agricultural Extension: Sector Study: Overview of Five Country Studies.* Washington, D.C.: World Bank

This report combines information gathered from five countries in the Sahel (Burkina Faso, the Gambia, Mali, Mauritania, and Senegal) and looks at the roles filled by women in agriculture and the constraints faced by women. A substantial percentage of households have women as *de facto* heads. Though circumstances vary from region to region, in general the workload shouldered by women in the Sahel is increasing due to various factors such as environmental degradation, pastoral people settling near towns, the absence of males in the household, increased demand for women's labor, and social change. Women receive no compensation for their extra labor, and their available time for individual income-generating and group activities is decreasing. The study points out the diversity of women's activities and argues that for extension services to be successful, they must be tailored to the needs of the inhabitants of particular regions. Women's activities tend to be risky and not very profitable, making it crucial to improve the flow of information to them. If the focus of services is mainly capital investments, the efforts will be misdirected. All five countries have made efforts to integrate gender issues into extension services. A large majority of extension agents are male, and the report provides some recommendations as to how this situation can be made more beneficial for female farmers. The last section of the report describes some specific steps taken by the particular countries to improve gender equity.

Zeller, M., A. Diagne, and C. Mataya. 1997. Market access by smallholder farmers in Malawi: Implications for technology adoption, agricultural productivity and crop income. Paper presented at the International Association of Agricultural Economists, Sacramento, California.

Given limited off-farm employment opportunities in Malawi, increases in household income to improve food security must come from gains in agricultural productivity. Using household survey data from 1995, the authors analyze the determinants of adoption of hybrid maize and tobacco. They find that in addition to factor endowments and exposure to agro-ecological risks, differences in the household's access to financial and commodity markets significantly influence cropping shares and farm incomes.

Zepeda, L., and M. Castillo. 1997. The role of husbands and wives in farm technology choice. *American Journal of Agricultural Economics* 79(2): 583–88.

Three models of technology adoption for farm households are considered. They include a conventional model, in which an individual chooses a technology to maximize the expected utility of the value of profit of the technology; a unitary household model, in which a time constraint and the possibility of off-farm employment are also included; and a bargaining model, in which individual household members allocate the resources within their control to maximize their own utility. Data from a survey of Wisconsin dairy farmers are used to estimate and compare the three models. The bargaining model is significantly better at explaining the decision of whether to adopt intensive rotational grazing. This paper provides insights into how to adapt bargaining models to technology adoption decisions.

Zuidberg, L. 1994. Burkina Faso. Integrated rural development: For whom and with whom? In V. Gianotten, V. Groverman, E.V. Walsum, and L. Zuidberg (eds.), ***Assessing the Gender Impact of Development Projects: Case Studies from Bolivia, Burkina Faso and India.*** **London: Intermediate Technology Publications. Pp. 49–70.**

This paper assesses the gender impacts of an ongoing development project in Burkina Faso and presents results from a detailed gender-focused analysis of the region. Many proposals of the development effort were vague, so specific gender impacts could not be determined. Plans aimed directly at women focused exclusively on their reproductive capacity and were not integrated into larger development projects. A comparative analysis of three Mossi and three Gourounsi villages shows that men and women farmers operate under very different circumstances at the village and household levels. The study examines the gender differences in division of labor and workload; reproductive and communal activities; access to, and control over, resources, income, and expenditures; participation in decision-making; and organizational capacity. Mossi women are strongly involved in cereal production and grow maize along with their husbands. Gourounsi women help only with sowing and transporting the harvest. The need for clear analysis and thought concerning gender issues is critical to development efforts of any crop. The author concludes that development projects need to do more than pay lip service to gender issues; they are critical to the mainstream development project and must be analyzed and considered closely.

Zwarteveen, M.Z. 1996. ***A Plot of One's Own: Gender Relations and Irrigated Land Allocation Policies in Burkina Faso.*** **Washington, D.C.: CGIAR Secretariat.**

The Dakiri irrigation system in Burkina Faso is one of the few irrigation projects where women were allocated their own irrigated plots. Sixty women (about 9% of the total number of plot holders) were allocated plots. Most of their husbands also received plots. Households in which both women and men had irrigated plots were compared with households in which only men had irrigated plots. The productivity of land and labor was higher in households in which both held plots. The author notes that these households did have a higher total amount of irrigated land, but does not address the issue of which women received irrigated plots.