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Is Feminization of Agriculture Occurring in China?

Debunking the Myth and Measuring the Consequence of Women 's Participation in Agriculture[1]

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Abstract

The goals of this paper are to help build a clear picture of the role of women in China's agriculture, to assess whether or not agricultural feminization has been occurring, and if so, to measure its impact on labor use, productivity, and welfare. To meet this goal, we rely on two high quality data sets that allow us to explore who is working on China's farms, and the effects of these decisions on labor use, productivity and welfare. The paper makes three main contributions. First, we establish a conceptual framework that we believe commences an effort to try to more carefully define the different dimensions of agricultural feminization and its expected consequences. Second, we make a contribution to the China literature. Perhaps surprisingly, we believe we have mostly debunked the myth that China's agriculture is becoming feminized. We also find that even if women were taking over the farm, the consequences in China would be mostly positive—from a labor supply, productivity and income point of view. Finally, there may be some lessons for the rest of the world on what policies and institutions help make women productive when they work on and manage in a nation's agricultural sector. Policies that ensure equal access to land, regulations that dictate open access to credit, and economic development strategies that encourage competitive and efficient markets all contribute to an environment in which women farmers can succeed.

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1. INTRODUCTION

Agricultural feminization is spreading throughout the world. Researchers are documenting increasing participation by women in farming in many parts of the world. Deere (2005) argues that, although the trends are stronger in some countries than others, there is solid evidence of agricultural feminization in Latin America. Ganguly (2003) documents the rise of agricultural feminization in India. A large literature on the role of women in agriculture is emerging in Africa as well (see, for example, IFAD, 1999).

While the process of agricultural feminization is complicated and the consequences are multi-dimensional, several authors are concerned about a number of potential effects of agricultural feminization on women's welfare. Song (1998) is concerned that women are being forced to work more hours and take on increased responsibilities, presumably reducing their welfare level. Katz (2003) worries that there could be negative effects on the income of women since women likely will have less access to resources—such as high quality land and credit. If women are being denied opportunities to participate in the "modern" wage earning sector and are relegated to working on the farm, the more indirect link between effort and income

from farm activities reduces their status (Gao, 1994). A study by the UNDP (2001) raises the concern that if women took over the farm, productivity might fall to the point that it could threaten national food security.

In part due to the perception that these concerns are valid, agricultural feminization has become an important topic in the literature on China's drive for modernization. Despite the absence of large scale studies, published and unpublished studies of the role of gender in China's agriculture argue that agricultural feminization is occurring—especially in China's poor areas (Song and Jiggins 2000; UNDP 2003; Song and Zhang 2004). Jacka (1997), for example, quotes county officials in Sichuan as saying that agriculture is being feminized. Rawski and Mead (1998) produce aggregate trends at the provincial level suggesting that women are taking over farm work in China.

And as elsewhere in the world, there is a debate on the effect of agricultural feminization in China. On one hand, some scholars say that when women are being left to tend the fields and have poor access to off-farm employment, they earn less than men for their on-farm work and have lower welfare (Song and Jiggins, 2000). Gao (1994) suggests the contribution of women to household income has declined as their role on the farm has emerged. On the other hand, given the sustained, statistically significant increase in agricultural productivity during the past 15 years (Jin et al., 2002), it is difficult to believe that agricultural feminization could have a substantial, negative effect on productivity.

When we read the literature on agricultural feminization in China, in fact, we find it difficult to take a stand on either the nature of the trend towards feminization or how it is affecting either the households that are being run by women or the agricultural sector, in general. Most previous analyses focus on only part of the country. Others only consider one dimension of agricultural feminization. Most studies treat rural women as if they all belong to a single group, instead of considering that agricultural feminization might affect women in different cohorts or members of different families in heterogenous ways. Few studies have attempted to quantify certain key issues, such as how much women have participated in on farm activities, especially relative to men. Have women taken more responsibilities in managing the farm? There are almost no econometric studies that either seek to understand how the changes in the participation rate of women in farming are associated with the participation rate of women in the labor force or try to measure the productivity effects of a woman-managed farm versus one managed by a man. In general, one can conclude that the bits and pieces that are found in the literature are sometimes inconsistent and often incomplete.

The overall goal of this paper is to contribute to the ongoing discussion on the changing status of women in China's rural labor markets and women's role in agricultural production by trying to answer the questions posed above. Specifically, we have three objectives. First, we develop an analytical framework for studying agricultural feminization. Second, we turn to farming and seek to answer the question: Is agriculture in China being feminized? We use large, national-level data sets to see

if women are contributing increasingly more labor to farming and/or if they are taking on a greater managerial role, by several different measures. Finally, we seek to quantify the effect that agricultural feminization (if it is occurring) will have on the labor supply of women, the income of women-headed households and the productivity of women-managed farms. Ultimately, we seek to draw lessons from our work for the literature on the role of women in development, agricultural feminization and China studies.

To meet the objectives, the rest of this paper is organized as follows. Section 2 introduces the datasets used in analysis. In Section 3 we briefly discuss the conceptual and measurement issues related to feminization and its impact. In sections 4 and 5 we investigate whether agriculture is being feminized in rural China and measure its impact. We primarily explore the welfare impacts on rural households, especially on women themselves in terms of income, access to markets and credit, as well as on agricultural productivity. The final section concludes.

2. DATA

The data for this study come from two sources. The first data set was collected in a randomly selected, nearly nationally representative sample of 60 villages in 6 provinces of rural China during November and December of 2000 (henceforth, the China National Rural Survey or *CNRS*). The provinces are Hebei, Liaoning, Shaanxi, Zhejiang, Hubei and Sichuan.[2] To ensure broad coverage within each province, one

[2] The data collection effort involved students from the Center for Chinese Agricultural Poli cy of the Chinese Academy of Sciences , Renmin University, and China Agricultural University. It was led by Loren Brandt of the

county was randomly selected from within each income quintile for the province, as measured by the gross value of industrial output. Two villages were randomly selected within each county. The survey teams used village rosters and a census of households not included in the village's list of households to randomly choose the twenty households; both households with and without residency permits *(hukou)* in the village were included. A total of 1,199 households were surveyed.

The CNRS gathered information on household demographics, labor allocation, agricultural production, and non-farm activities. Several parts of the survey were designed to learn about the household's participation in labor markets over time. For roughly half of the households surveyed (610 out of 1,199), a twenty-year employment history form was completed for each household member and each child of the household head.[3] For each year between 1981 and 2000, the questionnaire tracked each individual's participation in farm and off-farm employment, the main type of off-farm work performed, the place of residence while working (within or outside the village), the location of off-farm employment, and whether or not each individual was self-employed or wage earning. Time spent in rearing small amounts of livestock (e.g. one pig or a small flock of fowl) was counted as time spent doing housework rather than as time spent farming.

The CNRS also collected detailed information about each household member's on-farm work in 2000. After asking whether or not they worked on farm, each household

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University of Toronto, Scott Rozelle of the Stanford University, and Linxiu Zhang of the Center for Chinese Agricultural Policy. Households were paid 20 yuan and given a gift in compensation for the time that they spent with the survey team.

[3] The survey asked these questions about all children of the household head, even if they were no longer considered household members. The subs ample asked about the employment history was randomly chosen.

member was asked about the number of weeks they worked on the farm during the busy and slack seasons, the number of days they worked in each season, and the hours spent working on the farm on a typical day in each season. By adding up the number of hours they worked overall in the busy and slack seasons, we can calculate the number of hours each individual in the household worked on the farm in 2000. Enumerators also asked men and women how much housework they typically did during the busy and slack seasons.

The second data source is a subset of the China Health and Nutrition Survey (*CHNS*), collected by researchers at the University of North Carolina at Chapel Hill and their domestic collaborators in 1991, 1993, 1997, and 2000.[4] We use data that were collected in over 2,000 households in rural areas of seven provinces: Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, and Shandong.[5] Although the data include a panel of households, we work with the repeated cross-section, to avoid both bias related to attrition and cohort bias, as the panel ages over time.

The questions asked about labor allocation in the CHNS were structured somewhat differently than the questions in the CNRS. Regarding agriculture, the CHNS asked how many hours per day, days per week, and months per year each individual worked in the garden (vegetable plots near the house), on the farm, on livestock, and in fishing. They did not account for differences, as the CNRS did, between the peak and the off-peak seasons.

[4] We omit the data collected in 1989, because the questions on time allocation are not comparable to the questions asked in the following three periods.

[5] The CHNS is conducted in both rural and urban areas; we include data both from rural areas that can be considered suburban and more rural villages (but not county capitals in rural districts).

3. MEASURING AGRICULTURAL FEMINIZATION AND ITS CONSEQUENCES

One of the reasons that the facts about agricultural feminization and its impact are ambiguous, and in some cases contradictory, is that the literature often fails to offer a clear definition of agricultural feminization. In this paper we assume that there are two distinct types of agricultural feminization. First, the **feminization of agricultural labor** (or *labor feminization*) occurs when women perform an increasing share of on-farm work within the household. While there are two possible definitions—one, that women have increasingly higher participation rates in farm work; and two, that the women's share of agricultural labor shifts from less than half to more than half, in this paper we use the first definition of labor feminization. To measure increasing participation, we use three metrics: a.) An increasing number of women who at some time in the past did not participate in on-farm work and now do (participation measure); b.) A rising number of hours worked by women on the farm (hours measure); and c.) A rising share of hours of farm work done by women within the household relative to men (household share measure). To measure feminization, measures are needed over time (or need to be thought of as time varying) and, in many cases, the trends of participation and hour measures need to be interpreted relative to trends among men.

The second type of feminization is the **feminization of farm management** (or *managerial feminization*). Managerial feminization occurs in one of two ways: first,

when women increasingly become the primary decision maker on the farm; or, second, when they gain greater access to agricultural income (or dominate the execution of specific agricultural activities in which income is collected—e.g., the marketing of the crop; etc.). Measuring managerial feminization is a bit trickier than measuring labor feminization (which involves counting heads or days/hours). One measure is a count of households that call themselves nominally "women-headed households." In China, women typically become the head of a household when the husband of the family is no longer formally a member of the village—either through death, being chronically sick, or having shifted his formal household registration permit outside of the village (e.g., if he somehow managed to obtained an urban household registration permit). The weakness of this definition is that in many cases it undercounts the number of households in which day-to-day operations of the farm (and other family business—both production and consumption) are handled by the women (e.g. when the husband is a long term migrant and rarely returns home). This is called the nominal farm manager measure.

Since the nominal farm manager measure is imperfect, we use a question on the employment history form to create an alternative measure of woman-managed farms, which we call the primary farm manager measure. For each individual for each year since 1981 (or since an individual entered the labor force) we have a measure of the amount of time that he/she spent farming. For each person that worked, they are coded as working full time off the farm, principally working off-farm but working on the farm in the busy season, working part-time on the farm, and working full time on

the farm. We isolated the primary couple in each household to find households in which the man did little work on the farm (e.g. worked full-time off the farm or worked on the farm only in the busy season) and the woman primarily worked on the farm (e.g. either worked part-time or full time on the farm).[6] We then characterize these households as *women managed farms.* Since we do not observe which farms are truly women managed, this primary farm manager measure is also imperfect, but likely captures more women managed farms than the nominal farm manager measure.

Finally, it is also important to understand whether or not the woman has control over the earnings generated by farming. Regardless of the number of total hours that a woman puts in and regardless of whether or not she or the husband lives at or away from home, we examine whether women actually handle crop sales within the household, which we call the earnings access measure. If women are taking over either labor or managerial tasks on the farm, if they do not have direct access to the crop income their welfare is more likely to be reduced.

Ex-ante Hypotheses on Consequences of Feminization

One of the main reasons that writers on agricultural feminization appear to come of different conclusions is because there are many expected consequences—some which are expected to be positive; others which are expected to be negative. In the case of labor feminization, when the number of hours that a woman works on the farm rises, many observers believe or assume that utility levels among women decrease due to the additional effort they must exert. From the perspective of

[6] In most cases, there was only one primary relationship in the household.

neoclassical economics, one would expect that individuals only exert effort if the additional utility gained from working harder (due to increased income and therefore consumption) outweighs the disutility from exerting that effort. However, household farming distorts the direct link between effort and additional income or consumption. Therefore, many writers assert that increased labor in farming also does not lead to higher incomes that produce higher consumption for the woman herself or her family. To follow this logic, one would have to argue that because women do not control the income from farming within the household, they would not reap any additional benefits from their increased effort. However, if women do increase the amount of farm work done by households, households should not only gain additional income from on farm activities, but also even more income may be available to the family if the husband's labor is freed up to pursue other income-earning activities. Therefore, the consequence of more hours worked by the women on the farm is ambiguous in welfare terms. To the extent that the woman can claim more income as her labor input increases, the more positive (or less negative) will be the effect.

Managerial feminization also has multiple potential effects on the welfare of women, which may be offsetting. First, in the same way that labor feminization leads to lower utility by the increased effort that women must put out as they take on more of the labor burden of farm management, managerial feminization increases the time that women must work on the farm. It also increases the pressure that women face as they must live more with the decisions that must be made about farming activities. Both of these effects could reduce welfare levels for women.

Second, if the managerial ability of women—for any number of reasons (for example, because they have less experience or if they are not respected by individuals that farmers interface with)—is inferior to men, the efficiency of the farm could fall. The direct consequence of lower efficiency is that it could lead to lower household income. It also is through this mechanism (lower farming efficiency) that some believe agricultural feminization could lead to lower yields and ultimately to less food security. Therefore, it is not surprising that many observers believe managerial feminization could lead to negative effects for women and for farm productivity.

However, women managers might be more efficient at doing some farming activities. If the activity requires more intensive care, women could be better managers. When the woman manages the farm herself, it is also possible that she is positively rewarded by becoming more of "her own boss." She also might be better able to link her effort and her income—in contrast to the case when she is primarily putting in her labor at the direction of others (including her husband).

The effect of managerial feminization on individual and family income and yields will depend importantly on the access that women have to inputs and other resources needed for production. If women lack access to high quality land, water, credit and other inputs, it is clear that farms managed by women could produce less income than managed by individuals (presumably men) with better access to these resources. Hence, to the extent that women have equal access to resources, the probability of producing equal or nearly equal farming income and yields will rise.

In summary, then, ex-ante it is difficult to predict the impacts of agricultural feminization, either from the labor or managerial perspective. There are a number of effects—some measurable, others not—that should affect the welfare of women. Even these effects, however, are both positive and negative.

4. DEBUNKING THE MYTH: ARE WOMEN TAKING OVER THE FARM IN RURAL CHINA?

If anything, the tremendous push of labor into the off farm market—which, as Rozelle et al. (1999) find, is composed mostly of men, especially in the early years—is one of the motivating forces behind the rise of the concern of agricultural feminization. According to Deininger and Jin (2006), by 2004, nearly 125 million individuals were in the migrant labor force. When significant numbers of men are observed moving out of rural areas, a natural question arises: who is doing the work on the farm? Since the time endowment of a household/individual is fixed, if an individual is spending more (less) time off the farm, *ceteris paribus*, he or she will spend less (more) time on farm.

Moreover, in their study using the CNRS data, Zhang et al. (2004) find that although in recent years women at the youngest age group (16-20) move to the off-farm sector as frequently as men in the same cohort, more middle aged women (36-50) remain in rural areas despite their rise in off farm employment is not trivial. This finding almost certainly has implications for their participation in farm work. The questions that remain to be answered are whether such off-farm employment trends lead to agricultural feminization, and furthermore whether there are negative impacts

on women, their families and agricultural productivity. In section 5 of the paper, we will examine the effect on productivity of having women heavily involved in farming.

Although some hypothesize that the participation in farm work decreases welfare due to the disutility of increased effort and absence of a linkage between effort and income, one of the most important trends that appear in our data is that total hours spent per household on farm fell sharply during the 1990s (Table 1, row 1). According to the repeated cross-section of households in the CHNS, between 1991 and 2000 the average total hours spent per household on the farm fell from more than 3,500 hours in 1991 to just over 2,000 hours in 2000 (Table 1, row 1).[7] Furthermore, the proportion of households reporting spending any time on the farm dropped dramatically, from almost 89% of households in 1991 to 72% in 2000 (row 2). Since the CHNS sample was partially suburban, this change may reflect a larger decline than a more rural sample—urban areas expanded dramatically in China during the 1990s (Au and Henderson, 2006). Regardless, the number of hours worked by women in those households fell at almost the same rate (row 3)—whereas women worked an average of 1,943 hours in 1991, they worked only 1,081 hours in 2000. These recorded decreases in hours—which are occurring at the same time that off farm employment is rising rapidly—are consistent with the findings of Jin et al. (2002) and de Brauw et al. (2004), who find the hours spent on the farm fell during the 1980s and early 1990s as the reforms allowed rural households increasing access to off-farm activities. The fall in the number of hours spent on the farm

[7] The CHNS follows split households and replaces households that disappear between rounds, in order to better reflect the demographic composition of each community. The patterns are similar if we omit these households and only report the panel of households, although these households are aging.

also is reported in Li et al. (2006), who use panel data collected in approximately 100 households in northern Jiangsu..

The decline in the amount of time spent working on the farm is also observed in the husband-wife pairs used to derive the primary farm management measure. During the 1980s (1981-1990), 61 percent of husband-wife pairs both engaged in full time work on the farm. During the 1990s (1991-2000), this percentage declined to 43 percent.

Evidence of Feminization?

Labor Feminization. In an environment in which a considerable amount of labor is moving off the farm, it is not surprising that there should be growing attention to the study of those left behind, including the possibility that agricultural labor is potentially becoming feminized. However, while other factors (e.g., composition of the labor force) are not held constant, the CHNS and CNRS data also demonstrate that according to the *hour measure* there is little support for the labor feminization hypothesis (Table 1). During the 1990s, the average number of hours worked by men on their farms fell—as one might expect given the huge shift into the off farm employment sector and the overall fall in the number of hours worked on the farm (by 33 percent from 1,528 in 1990 to 1,021 in 1996; and further to 963 in 2000). Surprisingly, however, given the attention paid to agricultural feminization in China, the number of hours worked by women on the farm not only fell, they fell faster than those of men. According to the CHNS data, between 1990 and 1996, the number of hours worked by women fell from 1,542 in 1990 to 941 in 1996, a decline of 39 percent, 7 percentage points more than the average hours

worked by men on the farm. Clearly, according to the hour criteria, there is not any evidence of agricultural feminization.

The participation of women in agriculture—especially as full time farm workers—also declines faster than that of men. This can be seen by measuring the shaded white part of the graph between the upper trend line and the 100% line in Figure 1 (Panel B). While the participation rates of men working full time on the farm is lower throughout the 1980s and 1990s (ranging from 39 percent to 73 percent), due to their earlier and larger shift into the off-farm sector, the participation rate of women as full time farm workers declines faster. Since this measure of participation is the complement of the off-farm participation rate, this finding is not surprising, as the off-farm participation rate rises faster for women during the 1990s.

When we examine the proportion of farmwork done by women over time in the CNRS, we do not find evidence of labor feminization. Using the employment history, we create a measure of the proportion of farm work done by women in years prior to 2000. To do so, we estimate the fraction of a full-time worker that a part-time or busy season worker represents, for both men and women.[8] By aggregating the data up to the household level and measuring the proportion of farm work done by women in each household, we can estimate how the share of farmwork done by women changed

[8] In order to extrapolate the percentage of farm work done in each household by women back in time, we make some assumptions about these fractions. First, we assume that men and women work equal numbers of hours if they work full time on the farm. If they work part-time on the farm, we assume that they are equivalent to two-thirds of a full time worker, regardless of their gender. Finally, men who work only in the busy season are assumed to be equivalent to one-third of a full-time worker, whereas women who work only in the busy season are assumed to be equivalent to one-third of a full-time worker, since they are found to have significantly less farm involvement in 2000. We further assume that the fractions do not change over time.

between 1990 and 2000.[9] We account for households that are formed after 1990 and for members of the household alive in 2000 that leave or return to the household. To generate a confidence interval around the mean, each point was estimated using a simple bootstrap 1,000 times. We equate the contributions of men and women who work full time on the farm; in the 2000 cross-section, men worked slightly more, so the proportion of farmwork done by women reported here is likely overestimated. However, it is overestimated consistently in each period.

Figure 2 shows the estimated change in the proportion of the household farm workforce that is female over time. As suggested by the literature (e.g. Rawski and Mead, 1998), the proportion of farmwork done by women appears to increase slightly during the early 1990s. However, it peaks in 1995 and then declines thereafter falling by nearly five percentage points between 1995 and 2000. A drop in the percentage of farm work being done by women, on average, is certainly not consistent with a story of agricultural feminization in China. In fact, contrary to the common perception, according to this household share measure of labor feminization agriculture is being gradually defeminized after 1995.

Determinants of farm work done by females. Although the analysis of retrospective labor histories in the previous subsection suggests that agricultural feminization is not occurring in China, it does not control for household level factors that may affect the proportion of farm work done by women. In this section, we

[9] We only analyze the percentage of farm work done by women between 1990 and 2000, instead of over the whole period, because some individuals who may have worked on these family's farms during the 1980s may have died. This problem is not as substantial during th e 1990s.

analyze the determinants of the proportion of farm work done by women at the household level.

To explore the determinants of the proportion of household farm work done by women ($\bullet_h$), we regress $\bullet_h$ on the proportion of women in the household labor force P_h, a vector of household characteristics Z_h and a vector of demographic characteristics X_h:

$$\bullet_h = a + P_{hi} + Z_h P_1 + X_h \bullet_2 + \bullet_h \quad (1)$$

Since the dependent variable in equation (5) is a proportion, predictions after estimation may exceed the variable's boundaries (0 and 1). Therefore we estimate it using both OLS and a logistic transformation of the dependent variable ($Y_h = \ln(\frac{\mu_h}{1-\mu_h})$). Since women do no farm work in about 10 percent of the sample and all of the farm work in about 6 percent of the sample, we use an estimating algorithm that can deal with those observations.[10]

To execute this algorithm and estimate the determinants of women's work, we first use the CNRS cross section to estimate equation (5) (Table 2)[11]. Both estimation procedures give the same general results; coefficients have the same signs and generally coefficients on the same variables are significant. Referring to the OLS estimate, the point estimate indicates that an increase of 10% in the females in the household labor force leads to about a 7% increase in the amount of farm work done

[10] The algorithm is contained in the `GLM` procedure in Stata.

[11] We include provincial level fixed effects in estimating equation (5). The primary results are robust to the inclusion of village fixed effects. We use provincial fixed effects in lieu of village level effects to measure potential cultural differences in household organization across provinces.

by women (column 1, row 1). The signs on coefficients on the household characteristics are sensible as well. When households are headed by females, women do more farm work (row 2), while they do less farm work in households with more experienced, older heads (column 3). Women are likely to do more farm work in wealthier and more educated households, *ceteris paribus* (rows 4 and 6).

The most interesting coefficient estimates are found on some of the demographic variables. The presence of 16 to 25 year olds in the household has significant effects on the proportion of farm work done by women. This finding is not in itself surprising; if farming was the major source of income for most households, we would expect the addition of a new male laborer to the household (upon turning 16) to decrease the share of farming done by women, and the addition of a female laborer to increase the share of farming done by women. In fact, we find exactly the opposite (rows 7 and 8).

Using the results from the logistic transformation, we created a hypothetical household with parents between the ages of 46 and 55, at the mean level of all other variables in the sample. The addition of a 16 to 25 year old male or female to the household changes the percent of farm work done by women by about 20 percent. In other words, if half of the household farm work was done by the woman without the child, 70 percent was done by the woman if the child was male and 30 percent was done if the child was female. The result was similar if a sibling of the opposite sex also existed. The findings are consistent with a story that robust off-farm labor markets are available to younger workers, and they seem available to *both* men and women. Younger workers tend to be more educated, an important factor for finding off-farm

work in China (Yang 1997). However, if a gender wage gap existed, one would expect the presence of 16 to 25 year old women to have a smaller effect on the proportion of farm work done by women than 16 to 25 year old men have. The finding of coefficients of opposite sign and almost equal in magnitude implies that off-farm labor markets work equivalently for young men and women.

The second interesting finding regarding household demographics is that the presence of older women in the household has a negative effect on the amount of farm work done by women. According to both specifications' estimates, an additional woman over 55 in the household decreases the amount of farm work done by women (Table 2, row 15). However, the same is not true for men; the estimated coefficient on the men over 55 variable is positive, but statistically insignificant. The finding can be explained as follows. When women reach older ages, they either stop working altogether or shift their time into providing household goods. Men do not stop working; rather, they continue to work in the fields. The finding is consistent with research on labor allocation patterns among the elderly found by other researchers (e.g. Benjamin et al 2000; Pang et al 2004).

Managerial Feminization. Just as there is little evidence of the occurrence of agricultural feminization, there is little evidence of managerial feminization in agriculture. Unfortunately, China's national statistical bureau does not report the proportion of households in which a women is the household head, so we do not have a national measure of the change in female headed households over time. However, according to the CNRS data, only 3.2 percent of households in 2000 reported that they

were women-headed. Even if the proportion of women headed households was increasing, in absolute terms the increase could not be that significant. So by the nominal household head measure, there is little evidence of managerial feminization in agriculture.

Nor is there much evidence of a rise in women managed farms by the primary farm management measure. According to this measure, in the 1980s only 13.5 percent of households reported that farm activities were managed by the head's wife or the head (when female). In these households, the husband worked either part- or full-time off the farm and lived away from home (and at most returned for several weeks a year to work on the farm), while the wife at lived home and worked most of her time on the farm. Somewhat surprisingly, even after the high rate of migration out of rural China to its urban areas, women managed farms rose from 13.5 percent between 1990 and 1995 to 15 percent between 1995 and 2000. only by 1.5 percentage points to 15 percent. Moreover, whereas averages over five year periods increased, the point estimate for 1990 (15.3 percent of farms managed by women) is *higher* than the point estimate for 2000 (13.1 percent). Clearly, the primary farm management measure does not suggest a rapid increase in managerial feminization.

However, to the extent that women are taking over managerial tasks, our data suggest that they lack proportional access to the income earned from sales of agricultural commodities. According to the earnings control measure in the CNRS, women only marketed crops in 42 percent of households, while doing 50 percent of the farmwork. These averages suggest women may not control proceeds for their

work in agriculture, at least to some extent. However, we cannot speak to whether women are increasing or decreasing their participation in marketing, as we lack data over time on crop sales.

In summary, when we look at all measures—of both labor feminization and managerial feminization—there is almost no evidence that agricultural feminization is occurring. While it is difficult to dispute the multiple pieces of evidence, this argument is not consistent with the common perception among officials and researchers that agricultural feminization is a fact. Are these observers wrong? Is it happening for some groups but not others? Is feminization happening in some subsectors of agriculture, but not others? In the next subsection, we attempt to reconcile the discussion of agricultural feminization in the literature and the absence of agricultural feminization in our data.

Alternative Interpretations

Agricultural Feminization among the Middle-Aged Cohort. By computing the hours of farm work done by each individual in 2000, we can describe which demographic groups within households are farming, and the intensity by which they are farming (Table 3). The data indicate that, although men are still more likely to do farm work than women (70 percent of men do at least some farm work; only 65% percent of women do—rows 6 and 12), there are differences among cohorts. For example, among the youngest cohort of the household labor force, both males and females are much less likely than others to perform farm tasks, and they work less hours when they do work on the farm. Women between 16 and 25 are less likely to work

on the farm than men in the same age cohort– only 32.8 percent of women did any farm work, whereas 39.5 percent of men did (rows 1 and 7). Likewise, women in the older cohorts (46-55 and over 55) also participate much less in farming (86.0/40.4 percent) than men in the same cohort (90.3/69.2 percent).

In contrast, women in the middle aged cohort participated in farming at higher rates than men (Table 3, column 1, rows 2-3; 8-9). For example, women in the 36-45 cohort participate at rates that are somewhat higher than men in the same cohorts. Significantly, the on-farm participation rate are highly correlated to the gaps among the cohorts in the off farm labor trends. When cohorts of men are participating in the off farm labor market at higher levels (and they are doing so increasingly) than cohorts of women, back on the farm women are participating more. The reverse is true for the younger cohorts. In the older cohorts, as shown in Pang et al. (2004), the participation rate among women falls faster than the participation rate among men. As we explore in more detail below, this difference is related to elderly women's participation in non-paid housework and grandchild care.

Therefore, while there may be no general move towards agricultural feminization in rural China, it may be what social scientists are observing and taking as feminization is actually a phenomenon that is happening to middle-aged women. The middle-aged women agricultural feminization trend is consistent with cohort effects in the off-farm labor market. Whereas young men and women appear to obtain off-farm jobs in similar numbers, middle aged men are far more likely than middle aged women to work off-farm.

To understand the difference in the hours spent by middle-aged men and women, it is instructive to compare the effort expended farming by the intensity of work reported in the labor history for 2000 (Table 4). Men who report only working on the farm, on average, work slightly more–just over 1,000 hours per year–than women who report only working on the farm (943 hours; row 1). The same pattern is found for part-time and busy season farmers (that is, men work more hours than women). Meanwhile, not surprisingly full time farmers work more hours on average than part time farmers, and part time farmers work more hours than those who only farm during the busy season. Therefore, these averages make it clear that middle aged women do not work more on the farm than middle aged men because women outwork men who are doing the same type of work, but rather middle aged men are more likely to have off-farm employment than women. As a result, they are more likely to be part time farmers (and work less farm hours) than middle aged women. So while there is evidence of agricultural feminization among middle aged cohort, it is important to note that the typical middle aged man is working slightly less than middle-aged women on the farm because they are also working off the farm.

Livestock Sector and Future Feminization? The involvement of women in the livestock sector may mean that feminization, while not happening yet, may still occur in the future. In fact, our data—coupled with the sectoral shifts that have been occurring in the overall agricultural sector—provide evidence that there has been feminization in livestock production and that women's participation in the livestock sector contributed to overall feminization (however, not enough to outweigh other

forces—that were defeminizing agriculture in China). Specifically, the argument is built in part on the findings in our data that both the participation in the livestock sector and the hours worked in the sector (conditional on participating) are far higher for women than for men. In fact, our CNRS data show that 59 percent of those that were involved in livestock activities in 2000 were women. Furthermore, 64 percent of the hours input into livestock activities were by women. It appears that livestock sector in rural China is heading towards feminization.[12]

The effect of women's participation in livestock on feminization becomes evident when looking at the nature of changes in the composition of agricultural output. Statistics published by the China National Statistics Bureau (2006) show that in the early 1980s, livestock accounted for 18 percent of total agricultural value added. The share rose to 30 percent by 2000 and to 34 percent by 2006. These figures are consistent with the simulation model detailed in Huang and Chen (1999), who suggest the share of livestock output in the total value of agricultural output will reach more than 40 percent by 2020. If men do not begin to raise livestock, it can now be seen how the change in the structure of China's agriculture—over the past decade and into the near future—means that the high rate of participation by women (assuming it will continue into the future) could increase the pressure on agricultural feminization in general. Feminization may occur gradually through structural change, rather than women taking over tasks that men had previously performed.

[12] Although an even higher percentage of hours of livestock rearing were performed by women according to the CHNS—85 percent—it is not changing over the early to mid 1990s, which would argue against a feminization of the livestock sector. However, to the extent that the livestock sector is growing, the overall amount of farm work done by women could be increasing.

Even though women seem to be doing more work managing the farm and running livestock operations, men still control key phases of marketing process., a phenomenon that will dampen any conclusion that managerial feminization is also happening. Whereas women contributed 64 percent of the production work in livestock, men control 59 percent of the marketing work. This is a sign that as far as the traditional female-dominated livestock sector is concerned that feminization is more labor feminization, and not, according to the earnings-control measure, managerial feminization.

5. IMPACTS OF THE PARTICIPATION OF WOMEN IN AGRICULTURE

Although broad agricultural feminization is not occurring in China, a large portion of China's farm labor force is female and it seems that an increasing number of farms are being run by female managers. So what are the implications of having women involved in agriculture as managers? If new forces or continuing structural change did begin to feminize the on-farm labor and managerial force, what impact would feminization likely have on productivity, income and other welfare indicators? This section seeks to measure the impacts associated with being a female run or managed farm.

Impact of Changes in Woman's Labor Market Participation

While admittedly not answering the exact question of what would have been the effect on women had there been feminization (or if there is in the future), most of the effects of what *actually* has occurred in China's labor markets, in general, and in

on-farm labor, in particular, during the past two decades are positive. Hours working off the farm have risen, and wages and other off-farm earningshave been primary contributors to increasing rural household incomes. The more direct link between effort and wages means that women who have entered the workforce likely have had access to increasingly more of their earnings. To the extent that male-earned wages make their way back into the family budget and assets (e.g., de Brauw and Rozelle, forthcoming), higher earnings (by women and men) certainly have ended up increasing the standards of living of the rural population, even among the poor (Du et al, 2005).

Simultaneously, many trends in farming also suggest a positive story. Hours worked on the farm have fallen while crop incomes have risen. Although we lack a more direct link between agricultural earnings and effort, it is less certain that women have access to the rising income from farming, to the extent that they do (coupled with falling labor input), welfare for those working on the farm will have risen. The work of Huang et al. (2005) shows that rising technology, improving markets and emerging land rental markets have helped maintain farm income while farm labor inputs declined.

Effect of Managerial Feminization

In this subsection we examine the effect on productivity and income when women run the household. Since any differences in productivitu for women-run farms will depend on whether or not women have equal access to inputs and the other resources that are used for farming, we first consider this question. We then examine

the impact of female managed farms, using several different definitions, on crop income.

Access to Land, Markets, and Credit Services. If rural women play important roles in the rural economy, as a whole, it is also important to understand if there exist any barriers that they may face in fulfilling their responsibilities and providing for themselves and their families that are different than barriers faced by men. In contrast with much of the literature in other countries, our data show that women-managed households have relatively equal access to many of the key inputs required for farming (Table 5). First, the family labor available to women-managed farms and other farms are almost the same (3.99 per household and 4.07 per household—column 1). In addition, the quantity and quality of land and access to irrigation also differ little between women-managed farms and other farms (columns 2 to 4). Furthermore, our data show almost no difference between women-managed farms and other farms in terms of credit access or borrowing. Female farm managers have almost equal access to credit, and conditional on borrowing, they and their male counterparts both borrow, on average, from two or more individuals or institutions. Both men and women rely almost equally on friends and formal financial institutions (e.g., banks, credit cooperatives). In other words, women who manage their own farms in China appear to have almost identical access to labor, land and credit relative to men. Therefore, if there are differences in yields or cropping income, unequal access to resources is not the reason.

This finding is one of the most striking differences between China and the rest of the world. One potential explanation is that the institutional structure of China is set up to be fairly non-discriminatory. In the case of land, for example, village institutions almost always divide land on a per capita basis and are relatively fair when it comes to dividing plots by quality. In addition, banks—which are mostly state-run—also appear to not discriminate against farms managed by women (though the total volume of loans to farmers is relatively low). Finally, input markets work well in China, and so inputs such as fertilizer are extremely accessible to any one that wants to buy them. In other words, because of the institutions and depth of markets in China, there are few barriers that the average person—regardless of gender—face in obtaining access to productive inputs.

Impacts on Productivity

When assessing the impact of the reforms on women, one must address questions about whether or not their changing participation in agriculture can be associated with lower farm earnings. Internationally, women-headed households and women-cultivated plots have produced lower yields and revenues (World Bank, 2001). Women can be less efficient producers for a variety of reasons (Saito et al., 1994; Quisumbing, 1994). If true in China, then some of the gains women have received in the off-farm sector may have been offset by lower earnings in the farm sector.

Farms managed by women might be expected to be less efficient than farms managed by men in China, given that women are also much more involved in child rearing and housework than men. In order to answer the question of whether women-

headed households are more, less or equally efficient in cropping, we use a fixed-effects regression approach. Specifically, the logarithm of total cropping revenue for plot *i* farmed by household *h* in village *v*, y_{ihv}, is regressed on a measure of female management, Z_{hv}, a vector of household wealth and demographic characteristics $\mathbf{X_{hv}}$, and plot level characteristics $\mathbf{P_{ihv}}$.[13] The basic model is:

$$y_{ihv} = \alpha_v + Z_{hv}\gamma + \mathbf{X_{hv}}\beta + \mathbf{P_{ihv}}\theta + \varepsilon_{ihv} \qquad (2)$$

To control for differences in growing conditions, prices, and other unobservable factors across villages, we include a village-level fixed effect, α_v.

Our null hypothesis is that the coefficient on the female managed farm variable, $\gamma=0$, or that plot revenue is no different on farms run by women than on farms run by men. Since we lack a perfect measure of female farm management, we test four possible measures that are available in the CNRS. We initially use the indicator variable for a female headed household. Second, we use the nominal farm management measure, which is based on the employment history form, which was only asked in half of the sample households. To augment that measure, we also use a measure based on the reported off-peak hours worked on the farm by the husband and wife in 2000; if the husband either did not work on the farm or only worked on the farm in the busy season, while the wife worked on the farm either part-time or full-time (rather than peak season only), we code the household as a female managed farm. Fourth, we use the share of hours worked on farms by females.

[13] Plot level characterist ics include its size (in *mu*), irrigation status, farmer-reported quality, topography, the distance of the plot from the household and whether or not a shock occurred on the plot in 2000.

Using more than 4,500 plot-level observations for the analysis, we find results that are at odds with the results from other parts of the world (World Bank, 2001). Regardless of the measure of female farm management, we find no evidence that female farm management is negatively associated with plot-level crop revenues, holding household and plot characteristics constant (Table 6, rows 1 to 4). Therefore, we cannot reject the null hypothesis in any case that women are equally efficient as men at managing plot revenue. In fact, the point estimates for all four measures are positive, which would suggest that women may, if anything, be better farm managers than men in rural China. However, since our measures of female management are all imperfect, these results should be interpreted as suggestive rather than definitive.

That said, despite the fact that women have taken on significant responsibilities and provided a large fraction of farm labor, plot level earnings for farms women manage are at least equivalent to earnings on plots that men manage. The most direct interpretation of this result is, of course, that women are at least as good at farming as men. However, the results in Table 6 suggest that we cannot reject alternative interpretations. It could be that since women-headed households are frequently (though not always) those in which the husband permanently works outside of the village, such households face fewer capital constraints and therefore are able to produce more (although we hold wealth constant). It also could be that those farms that are women-run are not random. Rather, it could be that the only households that have farms that are women-run are those with particularly capable women.

Impacts on Income

One of the theoretical assumptions with female headed households is that they are less likely to earn as much income as their counterpart due to limited access to higher wage off-farm sectors. However, according to our data, families in which the wife takes over farming responsibilities does not seem to have a lower income than other households. In fact, for some reason (perhaps because when the wife manages the farm, the husband can take a job off the farm) the income per capita of a woman-managed farm household is higher. The average income of a woman managed farm household in our sample is more than 3,000 yuan/capita; the average income of other households is around 2,000 yuan. So households run by women appear to be at least as well of as those run by men.

6. CONCLUSIONS

The goal of this paper is to help build a clearer picture of the role of women in China's agriculture, to assess whether or not agricultural feminization has been occurring, and if so to understand dimensions of its impact. To meet this goal, we relied on two high quality data sets that allowed us to understand who is working on China's farms and impact they have had on labor use, productivity and welfare. In sum, the main task of the paper has been to describe some of the facts using a more national perspective than much of the literature.

In doing so, we have made three main contributions. First, we established a conceptual framework that we believe can help more carefully define the concept and dimensions of agricultural feminization, how to measure it, and how to think about its

consequences. In doing so we laid the groundwork for our paper that made it easier to track the trends of two types of feminization: labor feminization and managerial feminization.

The second contribution was to the China literature. We believe we have mostly debunked the myth that China's agriculture is becoming feminized. Our analysis—which uses different data sets, different measures and looking at different aspects of the problems—fundamentally finds that in China there has neither been a feminization of labor nor management in its agriculture. Women take on a large part of on-farm work (as well as an increasingly large role in off-farm work), but they appear to be putting on no more than half of the labor, their share of labor is not increasing and their role in management, while growing a bit, is still relatively minor. Even if women were taking over the farm, our analysis finds that the consequences in China would be mostly positive—from a labor supply, productivity and income point of view.

Finally, there may be some lessons for the rest of the world on what policies and institutions help make women productive when they work on and manage in a nation's agricultural sector. Policies that ensure equal access to land, regulations that dictate open access to credit, and economic development strategies that encourage competitive and efficient markets have all contributed to an environment in which women farmers can and appear to succeed. China has also begun to promote agricultural extension agents that are women. Although less than 30 percent of extension agents in China are women overall, nearly 40 percent of young ones are.

When women have access to inputs and information and new technologies, there is no reason that they cannot produce at levels equally efficient to men.

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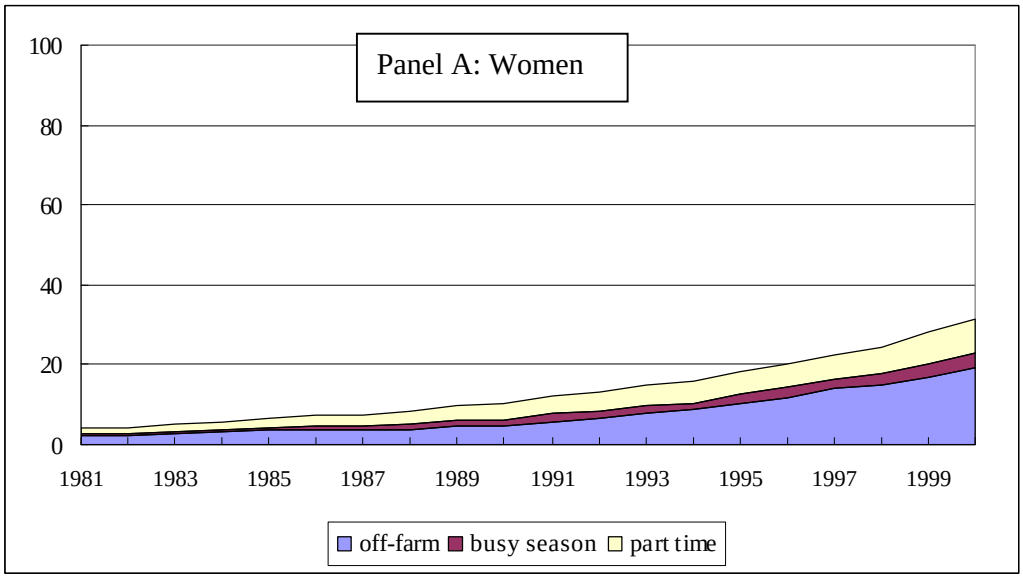

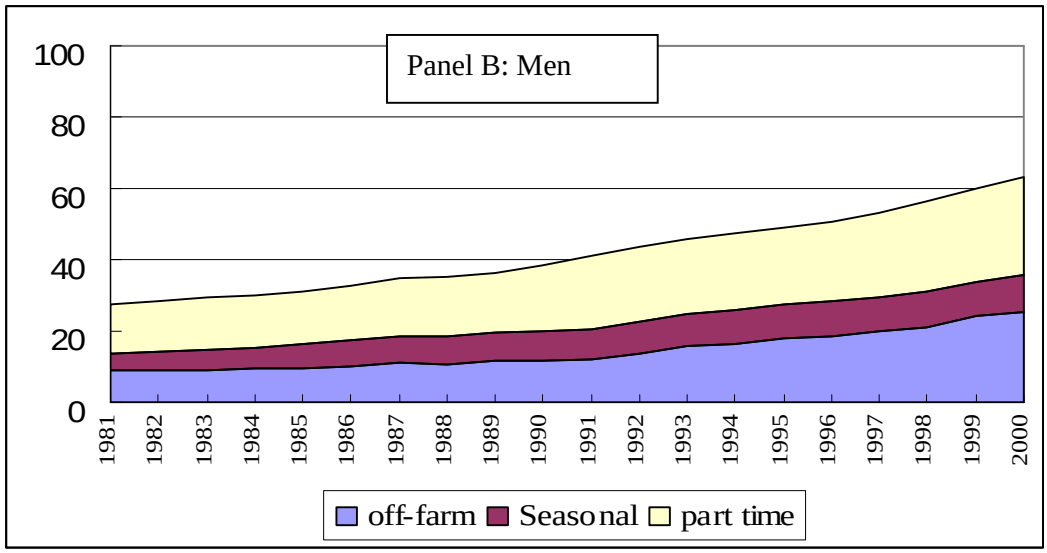

Figure 1. Increase in Off-farm Employment by Gender, 1981-2000
Source: Zhang et al. (2004).

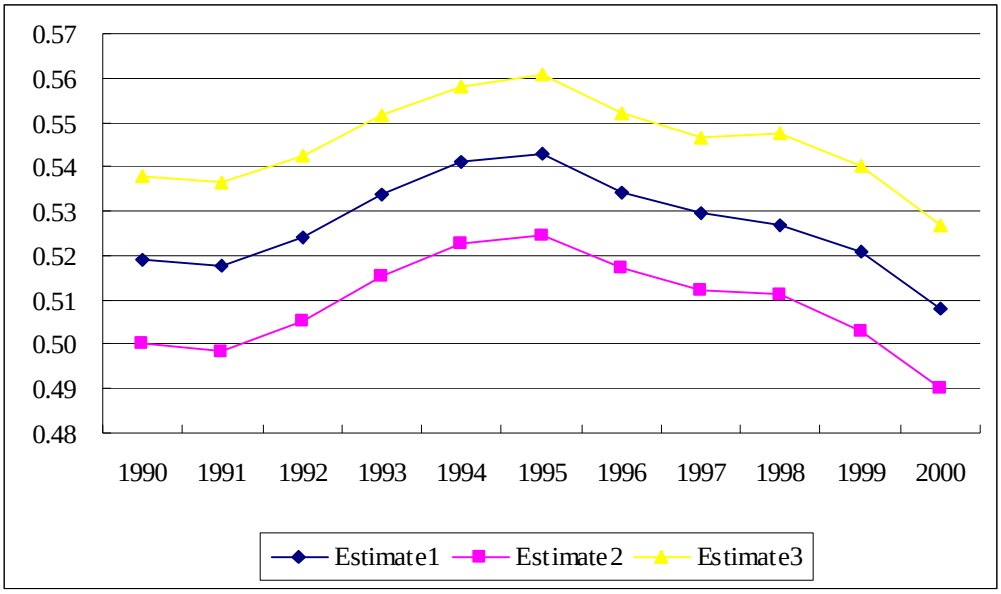

Figure 2. Estimated Proportion of Household Farm Labor Force that is Female, 1990 to 2000.
Source: CNRS.

Table 1. Participation in Farmwork by Men and Women, China Health and Nutrition Survey, 1991-2000

	Year			
	1991	1993	1997	2000
Average Total Reported Hours of Farmwork	3682	2851	2420	2023
	(3211)	(2510)	(2207)	(2177)
Share of Households Reporting Positive Hours of Farmwork	0.89	0.87	0.80	0.72
Average Hours of Farmwork Done by Women	1943	1487	1220	1081
	(1868)	(1481)	(1208)	(1237)
Number of Observations	2149	2105	2216	2314

Notes: Standard deviations in parentheses. Year refers to the year survey was completed. Farm work is defined to include time spent "gardening" and "cropping," and omits time spent tending livestock or fishing.

Source: CHNS.

Table 2. Determinants of the Proportion of Farm Work Done by Women, 2000

Explanatory Variable	OLS (1)	Logistic (2)
Proportion of Labor, Female	0.69	2.96
	(8.11)**	(6.10)**
Household Characteristics		
Female Head	0.073	0.287
(1=yes)	(1.82)*	(1.69)*
Experience of	-0.002	-0.007
Head	-1.57	(2.14)**
Log, Household	0.015	0.066
Wealth	(1.84)*	(2.79)**
Responsibility	-0.002	-0.009
Land (mu)	(1.88)*	-1.6
Mean education,	0.009	0.038
household (years)	(2.10)**	(2.53)**
Household Demographics		
Number males,	0.048	0.215
aged 16-25	(2.27)**	(2.53)**
Number females,	-0.054	-0.235
aged 16-25	(3.74)**	(2.95)**
Number males,	0.014	0.067
aged 26-35	-0.53	-0.57
Number females,	0.016	0.051
aged 26-35	-0.61	-0.43
Number males,	0.038	0.194
aged 36-45	(1.81)*	-1.52
Number females,	0.042	0.147
aged 36-45	-1.4	-1.13
Number males,	-0.015	-0.038
aged 46-55	-0.63	-0.34
Number females,	0.025	0.083
aged 46-55	-0.95	-0.68
Number males,	-0.001	0.016
over 55	-0.02	-0.15
Number females,	-0.06	-0.267
over 55	(3.11)**	(2.83)**

Summary Statistics		
N	1131	1131
Adj. R^2	0.221	

Notes: t-ratios in parentheses; standard errors calculated correcting fo r clustering at the village level. * - significant percent level. Provincial fixed effects are included in all equations but OLS, and column (2) reports results after transforming the dependent at the 10 percent level; ** - significant at the 5 not reported. Column (1) reports results using variable using the logistic transformation.

Source: CNRS.

Table 3. Farm Hours Worked and Percent of People Working on Farm, by demographic group, 2000

Demographic Group	Percent Working on Farm	Mean Hours in 2000	Standard Deviation
Men aged:			
16-25	39.5	550.8	523.5
26-35	76.5	792.9	677
36-45	86.7	860.7	696.1
46-55	90.3	891.9	697
over 55	69.2	832.6	665.5
All Men	70	803.3	671.9
Women aged:			
16-25	32.8	543.7	533.9
26-35	81.2	849.2	684.9
36-45	91.2	944.1	698.5
46-55	86.0	911.1	688.6
over 55	40.4	574.9	503.2
All women	65	827.1	673.7

Notes: Means and standard deviations are measured only among individuals working on farm. Sample size is 3794.
Source: CNRS.

Table 4. Farm Hours Worked by Level of Involvement in Farming, by Gender, 2000

Level of Involvement	Men	Women
Farm Work Only	1022.4	943.3
	(682.7)	(672.0)
Part-Time Farmer	711.9	598.6
	(570)	(555)
Busy Season Only	378.4	197
	(408.9)	(172.2)

Notes: Standard deviations in parenth eses. Sample size is 1620, and only includes the subsample for which employment history data is available.
Source: CNRS.

Table 5. Comparing the difference in access to resources/service among different type of householdss

Types of farms	Household Size	Cultivated Land per labor	% of good quality land	% of irrigated land	Number of individuals or institutions that you borrow money between 1995-2000	Friend or relative	Bank or other credit co-op
Women managed farms	3.99	2.73	72.83	66.40	2.26	82.76	13.79
Other farms	4.07	3.23	71.41	65.20	2.42	80.21	13.83
Total	4.06	3.18	71.55	65.31	2.40	80.61	13.82

Source: CNRS.

Table 6. Regression Analysis of the Relationship between Female Managed Farms and Plot Revenues

	Dependent Variable: ln(plot revenue)			
	(1)	(2)	(3)	(4)
Female Farm management Measures				
Female is Head (1=yes)	0.071			
	(0.058)			
Nominal Female Manager, based on employment history		0.019		
		(0.041)		
Nominal Female Manager, based on hours worked			0.053	
			(0.039)	
Share of Hours Worked, Females				0.069
				(0.050)
Household Characteristics				
Logarithm, Land Size	0.009	0.072	0.011	0.011
	(0.022)	(0.026)**	(0.022)	(0.022)
Logarithm, Household Size	0.043	-0.034	0.038	0.032
	(0.042)	(0.053)	(0.041)	(0.042)
Logarithm, Household Wealth	0.005	0.015	0.005	0.004
	(0.010)	(0.012)	(0.009)	(0.009)
Education of Household Head (years)	0.002	0.002	0.002	0.002
	(0.004)	(0.005)	(0.004)	(0.004)
Age of Household Head	0.0001	0.001	0.0004	0.001
	(0.001)	(0.002)	(0.001)	(0.001)
Plot Characteristics				
Irrigated? (1=yes)	0.293	0.328	0.294	0.292
	(0.031)**	(0.038)**	(0.031)**	(0.031)**
Distance to household (km)	0.004	0.002	0.003	0.004
	(0.011)	(0.011)	(0.011)	(0.011)
Log, Plot Area	0.990	0.989	0.990	0.990
	(0.016)**	(0.021)**	(0.016)**	(0.016)**
High Quality? (1=yes)	0.161	0.163	0.162	0.162
	(0.026)**	(0.034)**	(0.026)**	(0.026)**
Plot is Hilly (1=yes)	-0.092	-0.061	-0.093	-0.094
	(0.031)**	(0.039)	(0.031)**	(0.031)**
Plot is Terraced (1=yes)	-0.091	0.070	-0.087	-0.088
	(0.060)	(0.069)	(0.060)	(0.060)
Plot had shock in 2000 (1=yes)	-0.146	-0.178	-0.145	-0.143
	(0.028)**	(0.037)**	(0.028)**	(0.028)**
Single Season Plot	-0.321	-0.362	-0.321	-0.319
	(0.028)**	(0.036)**	(0.028)**	(0.028)**
Number of Observations	4547	2437	4547	4540

Notes: **- indicates statistical significance at the 5 percent level. Robust standard errors in parentheses.
All equations include village level fixed effects.
Source: CNRS.