



**Feminization of Agriculture in China:
Debunking the Myth and Measuring the Consequence of Women
Participation in Agriculture¹**

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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 track changes in of labor use over time. We use this data to examine the evolution of off farm and on farm employment trends and analyze the role of men and women in the emergence of China's labor markets. We 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 insure 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.

Feminization of Agriculture in China: Debunking the Myth and Measuring the Consequence of Women Participation in Agriculture

Agricultural feminization is spreading throughout the world. The literature is documenting increasing participation by women 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 (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 the potential effects. Song (1998) is concerned that women are being forced to work more hours and take on increased responsibilities, which supposedly reduces their utility. 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, most published studies of the role of gender in

China's agriculture argue the agricultural feminization is happening—especially in China's poor areas (Song and Jiggins 2000; UNDP 2003; Song and Zhang 2004). Jacka (1997) quotes county officials in Sichuan as saying that they believe 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.

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 positive and 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 understanding that the behavior of women in different cohorts or as members of different families may differ markedly. Few studies have attempted to quantify certain key issues, such as the degree to which women have participated in on farm activities, especially vis-à-vis men. Have women taken more responsibility in managing the farm? There are almost no econometric studies that either

seek to understand how the changes in the participation rates of women in farming is associated with the rate of women participation in the labor force or that 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.

Because of the absence of a clear picture of what is happening with such an important issue, the overall goal of this report 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. Specifically, we have four objectives. First, we develop an analytical framework for studying agricultural feminization. Second, we update trends in off-farm labor participation—which helps explain how what large segments of the labor force of both genders have changed their labor allocation as the economy has grown. Third, 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 literatures on the role of women in development, agricultural feminization and China studies.

To meet the objectives, the rest of this report is organized as follows. Section 2 introduces the datasets on which this report is based. In Section 3 we briefly discuss the conceptual and measurement issues related to feminization and its impact. Section 4

analyzes the emergence of off farm rural labor markets and quantify the participation of women in the off-farm sector. In sections 5 and 6 we investigate whether agriculture is being feminized in rural China and measure the impact of it, if it is. 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.

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.⁷ To ensure broad coverage within each province, one 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

⁷ The data collection effort involved students from the Center for Chinese Agricultural Policy of the Chinese Academy of Sciences, Renmin University, and China Agricultural University. It was led by Loren Brandt of the 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.

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.⁸ 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. All individuals who worked were coded as either working on the farm full time, part time, only during the busy season, or not working on the farm at all. 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 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 2000.⁹ Enumerators also asked men and women how much housework they typically did during the busy and slack seasons.

The second data source that will be used in the paper is a subset of the China Health and Nutrition Survey (*CHNS*), collected by researchers at the University of North

⁸ The survey asked these questions about all children of the household head, even if they were no longer considered household members. The subsample asked about the employment history was randomly chosen.

⁹ Descriptive statistics for variables constructed from the CNRS are in Appendix Table 1.

Carolina at Chapel Hill and their domestic collaborators in 1991, 1993, and 1997.¹⁰ We use data that were collected from roughly 2,000 households in each year in seven provinces: Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, and Shandong. The data from rural areas include both villages that are suburbs of urban areas and more rural villages. The researchers tracked a panel of 1,840 households over the three surveys, so the analysis will include both the larger repeated cross-section and the panel.

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.

MEASURING AGRICULTURAL FEMINIZATION AND ITS IMPACT

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. In this paper we assume that there are two distinct types of agricultural feminization. First, the **feminization of agricultural labor** (or *labor feminization*) is the process by which increasingly more of on-farm work is done by women. While there are two possible definitions—one, that women have increasingly higher participation rates; 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. To measure increasing participation, we use a number of metrics: a.) An increasing number of women who at some time in the

¹⁰ 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.

past did not participate in on-farm work and now do (participation measure); b.) A rising number of hours worked on the farm (hours measure); and c.) A rising share of hours of farmwork 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 hours 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 how many households 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 obtain 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 consumptive) 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 management 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. only worked off-farm or only worked on the farm in the busy season) and the woman primarily worked on the farm (e.g. either worked part-time or full time on the farm).¹¹ We then characterize these households as *women managed farms*. When the husband in the primary household relationship either works completely off-the-farm or only works on the farm in the busy season, we define the household as a *women managed farm*. Since we do not observe which farms are truly women managed, this measure is also imperfect, but likely captures more women managed farms than the nominal measure.

Finally, we create a third measure, which seeks 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, the earnings-access measure of managerial feminization depends on who actually took the farm output to the market and who handled the earnings from crop sales.

¹¹ In most cases, there was only one primary relationship in the household.

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 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 believe that increased labor in farming also does not lead to higher incomes that produces 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 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 in welfare terms of higher hours worked by the women on the farm will be ambiguous. To the extent that the woman is able to claim more income in some proportion with her labor input, 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 the 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 farming, 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 could produce less income than an individual (presumably a man) 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 feminization (either labor or managerial). There are a number of effects—some measurable, others not—that should effect the welfare of women. Even these effects, however, are both positive and negative.

OFF-FARM EMPLOYMENT, MIGRATION AND CHANGING ROLE OF WOMEN IN LABOR MARKET

The rise of the off farm sector in China, one of the most powerful forces in the economy since the reform, is absolutely necessary to understand when one is trying to assess the welfare of women over the past two decades. If anything, the tremendous push of labor into the off farm market—which, as will be seen, 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. In short, when the massive movement of men is observed moving out of the village, a natural question arises: who is doing the work on the farm? In short, since the time endowment of a household/individual is fixed, if an individual (or cohort of individuals) is spending more (less) time off the farm, *ceteris paribus*, they will spend less (more) time on farm.

Overall Contour of Off-farm Employment in Rural China

Above all, the CNRS data show the off-farm labor force expanded steadily and rapidly between 1981 and 2000. The data indicate that the proportion of the rural labor force that found some off-farm employment increased from around 16 percent in 1981 to 48 percent by 2000 (Table 1). By disaggregating China's labor trends, our data also demonstrate that labor markets are providing more than just off-farm income to rural residents and are developing in ways consistent with modernization trends (Chenery and Syrquin, 1975). Trends by employment type clearly show that the target destination of workers over the past 20 years has shifted from rural to urban (Figure 1). In 1981 most rural individuals (nearly 85 percent) spent all of the time they allocated to labor farming. Individuals who worked off the farm were almost three times as likely to live at home and work within or close to the village (7 percent were local self-employed; 4.2 percent were local wage earners) than to work outside of the village and live away from home (less than 1 percent were self employed migrants; less than 4 percent were migrants). By 2000 almost as many off-farm workers were living away from home (more than 85 percent in cities or suburban villages of major metropolitan areas) as in the village. Migrants composed both the largest and fastest growing component of the rural labor force. According to Deininger and Jin (2006), by 2004, nearly 125 million individuals were in the migrant labor force.

The labor movement contours created from the off-farm employment histories of different age cohorts demonstrate one of most striking characteristics of China's changing employment patterns: the shift towards off farm employment is dominated by younger workers (Table 2). Workers in all age cohort categories participated at similar rates in

1990 (ranging narrowly from 20.5 to 33.6 percent—column 1). One decade after the onset of the reforms, there was no clear progression when moving from the oldest to youngest cohorts. By 2000, however, the rise in the off farm participation rates of younger workers accelerated relative to older ones, and a distinct ranking appeared as one moved from the youngest to the oldest cohort (column 4). In 2000 young workers in the 16 to 20 year old cohort participated at rates more than three times (75.8 percent) those of 16 to 20 year olds in 1990 (23.7 percent). Those in the 21 to 25 year old cohort and the 26 to 30 year old cohort doubled the off-farm participation rates of their counterparts in 1990. In contrast, older workers, while still increasing their participation rates significantly (by 17 percentage points), worked off the farm at less than half the rate (only 37.6 percent) than those in the 16 to 20 year old cohort.

Participation in Off-farm Employment by Gender

In the same way that emerging rural labor markets may have had numerous effects on the fabric of rural and urban economies, the participation in labor markets by men and women vary (World Bank, 2001). In fact, according to our data, when examining the rate at which women have gained employment off the farm, the newly emerging labor markets began to positively affect women in a large way since the 1990s (Table 1, rows 2 to 3). Although women have participated at rates far below those of men throughout the entire 20-year sample period, participation rates have risen rapidly since the early 1990s. In the 1980s, consistent with the findings from the national community survey-based study reported in Rozelle et al. (1999), off-farm participation rates of men (more than 25 percent in 1981) far exceeded those of women (less than 5 percent). Moreover, despite

low initial levels of involvement in the off-farm sector, participation rates for women grew more slowly than those of men during the 1980s. In the 1990s, however, the participation rate of women in the off-farm sector increased faster than that of men.

Although women have been entering all employment sectors, the most striking increases have been in migration (Figure 2, Panels A and B). Throughout the 1980s, less than 1 percent of women left the farm and worked for a wage as a migrant. Since 1990, however, migrant labor force growth has been faster than any other category of job types for both men and women. By 2000, nearly 7 percent of the female labor force was working as wage-earning migrants.

Perhaps most poignantly, younger women are beginning to specialize by working solely in the off-farm sector. While off-farm participation rates are still lower for women than for men (by 32 percentage points—63 percent for men and 31 percent for women) in 2000 (Table 1, rows 2 and 3), the gap narrows for younger cohorts and disappears for the youngest (Table 2, columns 2 and 3; 5 and 6). Both men and women in the 16 to 20 year old cohorts have equal off farm participation rates (74.7 percent for men; 75.6 percent for women—row 1). Like men, women in this cohort are increasingly *specializing* in off farm labor. In fact, the majority of young women who work off-farm in 2000 do not work on the farm (59 percent). The shift of young migrants that specialize in off-farm work contrasts sharply with the situation in 1990 when most off farm workers continued to work on the farm on either a part time or seasonal basis.

With older cohorts, however, the gender gap in off farm employment participation remains, and the gap helps explain why it has been observed that during the reform era women perform a large fraction of the work on the farm (Table 2, rows 2 to 6). In fact,

differences in the growth rates among cohorts (measured in absolute percentage points) suggest that older cohorts of women have not fared as well as younger cohorts, in terms of finding off-farm work. While the rise in percentage points for women is the same or higher than that for men for the cohorts under 30, those for men are greater than for women for cohorts 30 and above. Consequently, the percentage point difference between male and females widens to 25.3 percent for 21 to 25 year olds; 39.1 percent for 31 to 35 year olds; and 48 percent for 41 to 45 year olds (rows 2 to 6).¹²

In summary, men and women are entering the off-farm labor market at the same rate in recent years, although there are still more men than women. To the extent that working off-farm bestows more benefits on individuals than work in the farming sector, there has been a relatively large rise in welfare due to the expansion of off farm employment. However, when disaggregated by age cohorts, women at younger age groups (16-20) move to the off-farm sector as frequently as men in the same cohort. In general, very few of them will likely to return to farming in the future.

The picture for middle aged women is different, as more middle aged women (36-50) remain in rural areas—although their rise in off farm employment is not trivial. This finding almost certainly (as we will see) 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.

¹² In addition, women in the age categories between 21 and 25 and between 26 and 30 also have a higher probability of not being in the labor force at all. In our entire sample, eight percent of the sample are neither working nor searching for a job; there are more than 10 percent of women between 21 and 30 that fall into this category. However, in almost all cases this is explained by the fact that they have children that are two years old or younger.

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

If participation in farm work decreases welfare (as some hypothesize—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 fell sharply during the 1990s (Table 3, row 1). According to the panel of households found in the CHNS, between 1990 and 1996 the average total hours spent per household on the farm fell from more than 3000 hours in 1990 to less than 2000 hours in 1996 (row 1, columns 1 and 3). To the extent that the CNRS data are comparable, between 1996 and 2000 the total hours fell further (columns 3 and 4). 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 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 were 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 an *hours measure* there is little support for the labor feminization hypothesis (Table 3). 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 1528 in 1990 to 1021 in 1996; and further to 963 in 2000). Surprisingly, however, given the attention given 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 1542 in 1990 to 941 in 1996, a decline of 39 percent, 7 percentage points more than the average on farm hours of men. Clearly, according to the hours criteria, there is not any evidence of agricultural feminization.

The participation of females in agriculture—especially as full time farm workers—also declines faster than 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 2 (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 (see also Table 2 above), 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.

We also find that there is no evidence of feminization when looking at the proportion of the household farm labor force made up of females (that is, when using the household

share measure of labor feminization). Using the employment history data, we create a measure of the proportion of farmwork 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.¹³ By aggregating the data up to the household level and measuring the percentage of farm work done by women in each household, we can estimate the mean percentage of women involved in farming in each year between 1990 and 2000.¹⁴ 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.

Figure 3 shows the estimated change in the proportion of the household farm workforce that is female over time. Somewhat surprisingly, in 1995, according to the CHRS data, women were performing 55 percent of on farm work on the family's farm. However, the proportion made up by women actually was falling afterwards. By 2000 less than 51% percent of on farm labor was being done by women. 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 measure agriculture is being gradually defeminized after 1995.

¹³ In order to extrapolate the percentage of farmwork 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.

¹⁴ 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 the 1990s.

Regression on determinants of farmwork done by females. Although the retrospective analysis 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 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 farmwork done by women, we regress the proportion μ_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 :

$$\mu_h = a + P_{hi} + Z_h P_1 + X_h \beta_2 + \varepsilon_h \quad (1)$$

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 using a logistic transformation of the dependent variable ($Y_h = \ln(\frac{\mu_h}{1-\mu_h})$). Since women do no farmwork in about 10 percent of the sample and all of the farmwork in about 6 percent of the sample, we use an estimating algorithm that can deal with those observations.¹⁵

To execute this algorithm and estimate the determinants of women's work, we first use the CNRS cross section to estimate equation (5) (Table 4)¹⁶. Both estimation procedures give the same general results; coefficients have the same signs and generally

¹⁵ The algorithm is contained in the `GLM` procedure in Stata.

¹⁶ 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.

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 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 farmwork 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 have significant effects on the proportion of farmwork 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 farmwork done by women by about 20 percent. In other words, if half of the household farmwork 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. The finding of coefficients of opposite sign and almost equal in magnitude implies that off-farm labor markets work for both 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 farmwork 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 4, 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, likewise 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, only 6 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.

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, during the 1990s, women managed farms rose only by 1.5 percentage points to 15 percent. Moreover, when the point estimate for 1990 is compared to the point estimate for 2000, the percentage of household farms managed by women is falling (from 15.3 to 13.1 percent). Clearly, there is little evidence of a surge in the rise of managerial feminization according to the primary farm management measure.

Finally, there also is little evidence that women are increasing their access to agricultural earnings (or direct access to the income generated during the sales of agricultural commodities). According to our earnings-control measure that was created from the CNRS data for 2000, women put in about 50 percent of the hours into farming (as seen above). However, their participation rate in marketing activities was only 42 percent. In other words, although women held up half of the farming sky, labor-wise, they under participate in selling the actual farm produce.

Therefore, 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, it does not resolve the puzzle about why it is that so many people are talking as if agricultural feminization is a fact. Are these observers wrong? Is it happening for some groups and not others? Is feminization happening in some subsectors of agriculture, but not others? In the next subsection, we turn to see if there is evidence that will help 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 5). 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 5, column 1, rows 2-3; 8-9). For example, women in the 26-35 cohort and those in the 36-45 cohort participate at rates that are somewhat higher than men in the same cohorts. Significantly, the on-farm participation rates are highly correlated to the gaps among the cohorts in the off farm labor trends (Table 2—above section). 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 also appears to be related to the cohort effects in the off farm labor market, which is another set of observed facts that social scientists are raising in the context of feminization.

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 6). Men who report only working on the farm, on average, work slightly more—just over 1000 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, from these figures it becomes clear that the real reason that middle aged women work more than middle aged men is not because women out work men who are doing the same type of work. Rather, because middle aged men are more likely to have off-farm employment, 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 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.¹⁷

¹⁷ 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 farmwork done by women could be increasing.

The effect of women's participation in livestock on feminization becomes evident when looking at the nature of changes to the composition of agricultural output. Statistics published by 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. According to the prediction that are consistent with the simulation model detailed in Huang and Chen (1999), the share of livestock output in total agricultural output value will reach more than 40 percent by 2020. Therefore, 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) will increase the pressure on agricultural feminization in general. In other words, feminization may occur gradually through structural change, rather than women taking over tasks that men had previously performed.

However, it should be noted that even though women are doing increasingly more in managing 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.

IMPACTS OF THE PARTICIPATION OF WOMEN IN AGRICULTURE

Although agricultural feminization is not occurring in China, a huge part of China's farm labor force is female and an increasing number of farms (although only

gradually so) are being run by female managers. So what are the implications of having women being involved in agriculture? 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 earnings off the farm) are one of the main ways that families have increased their incomes. The more direct link between effort and wages means that the 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., deBrauw 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.

Overall, however, women almost certainly are not putting in fewer hours on unpaid housework. In fact, it could be that if the time women were putting into unpaid housework were counted in their overall contribution to the farm, there is a more plausible basis to argue that women are contributing more than their share of the labor force to running the farm-household as a whole. According to our data from the CNRS survey, women in almost all cohorts during both the slack and busy agricultural seasons put more time into housework per day than men (Table 7, rows 1 to 5). Overall, women put in more than twice the number of hours into unpaid housework (2.45 hours/day) than men (1.21 hours/day) during the busy season and twice the number of hours during the slack season (3.18 hours/day for women and 1.53 hours/day for men). Hence, there still is a basis for being concerned about the welfare of women—especially middle-aged women—who are working longer hours on the farm, taking (gradually) on managerial duties and continuing to take on a large share of the housework burden.

Effect of Managerial Feminization

In this section we examine the effect on productivity and income when women run the household. Since (as discussed in the hypothesis section) this effect will potentially be affected by whether or not women have equal access to inputs and the other resources that are used for farming, we first look this question. We then examine the impact 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 on other countries, our data show that women-managed households have relatively equal access to many of the key inputs required for farming (Table 8). 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 banks. 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 participation in agriculture has led to lower earnings. Internationally, women-headed households and women-cultivated plots have produced lower yields and revenues (World Bank, 2001). Women are less efficient producers for a variety of reasons (Saito et al., 1994; Quisumbing, 1994). If true in China, then part of the gains that women have gained in the off farm sector have been offset by the lower incomes that they receive in farming.

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, total cropping revenue (see Table 9) for each of the household's plots is regressed on the plot, household and village characteristics that may determine plot-specific income.¹⁸ The basic model is:

$$y_{hv} = \alpha + D_{hv}\gamma + X_{hv}\beta + \mu_v + \varepsilon_{hv} \quad (2)$$

where y_{hv} denotes total income per capita or from one of the three specific sources for household h in village v . The variable, X_{hv} , is a vector of plot and household characteristics including the plot irrigation status, its quality, its topography, the distance from the household and the size of the shock (which vary by plot) and value of the household's assets, the size of the farm, the number of household members, and the age

¹⁸ In essence, we loosely follow Yotopoulos and Lau (1973), who examine economic efficiency by examining the profit function. Like Yotopoulos and Lau, since we have cross-sectional data, we cannot include prices directly; the prices, which vary by village, are captured by the village dummy variables.

and education of the household head (which vary by household). To control for differences in growing conditions, prices, and other unobservable factors across villages, we also include a village-level fixed effect, μ_v .

In addition to X_{hv} , we include a measure of the level of participation of women D_{hv} in farming in order to test whether or not women's participation on the farm affects farm efficiency.¹⁹ We try four different variables: the nominal farm measure (whether or not a woman heads the household); the proportion of the household's total labor force that is female (measured as the number of people); the proportion of the household's agricultural labor force that is female (also measured as the number of people); and the proportion of agricultural hours of the household worked by females (measured as the number of hours). The coefficient on the female participating in farming variable, γ , will provide the test for our hypothesis: holding all other things equal, if $\gamma=0$, then women-run farms are equally efficient in generating farm income when compared to male-run farms; the alternative hypothesis is that women-run farms are less efficient. Since we are interested primarily in whether or not women-run farms are less efficient, we use a one-sided hypothesis test.

Using more than 5,000 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). The coefficients on all four of the women-run farm variables are either zero or positive and significant (Table 9, rows 1 to 4). According to our data, then, when all of the other variables in our model are held constant, women-run farms are not less efficient than

¹⁹ Ideally, we would like to be able to include an indicator variable that is 1 when a woman is primarily in charge of the farm and zero otherwise. Unfortunately, from our data it is impossible to tell in which households women make all or most of the important farming decisions. Therefore, we test a number of different variables that could indicate that a farm is run by women (or a farm in which a large fraction of the labor is provided by women), in order to capture several different possible definitions of "women-run farms."

those of men, implying that women-run farms earn at least as much revenue on their plots as farms run by men. In terms of our hypothesis testing framework, at a 1 percent level of statistical significance, we cannot reject the null hypothesis that women-run farms are equally efficient as men-run farms at generating revenue.

Hence, according to our findings, although women during the course of rural China's recent development have taken on great responsibilities (and provided a large fraction of labor) on the farm, the earnings in these farms have not suffered. The most direct interpretation of this result is, of course, that women are at least as good as at farming as men. However, the results in Table 9 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 3000 yuan/capita; the average income of other households is around 2000 yuan. Statistical t-tests for the different between cropping income of women-managed farming families and other households suggest that there is no difference in cropping income.

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 track the changes of labor use over time. We examined the evolution of off farm and on farm employment trends, and the role of men and women in the emergence of China's labor markets. Finally, we have tried 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 use 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. 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 insure 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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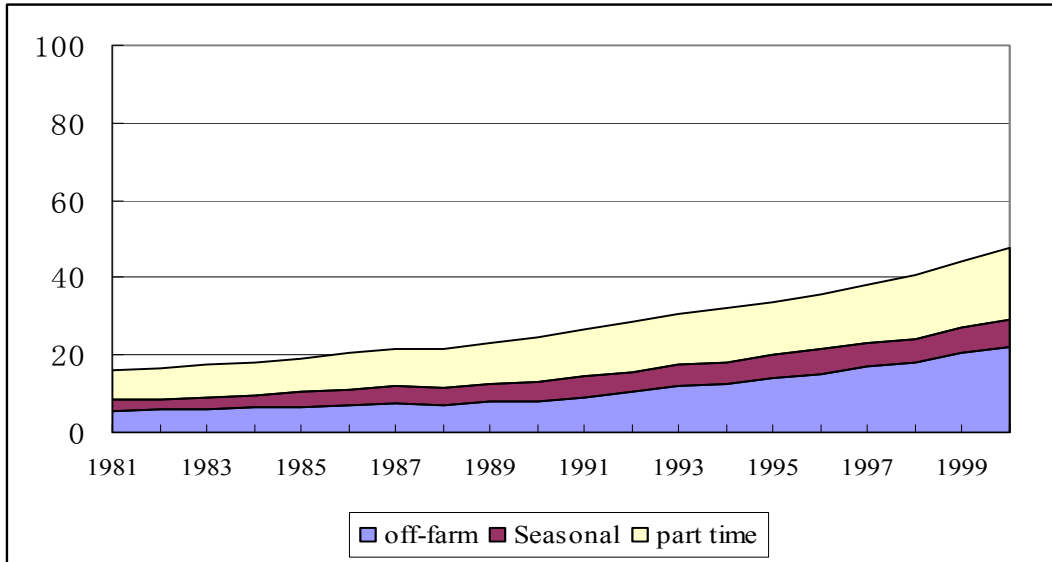


Figure 1. Percentage of rural labour force participated in off-farm employment, 1981-2000.

Source: CNRS.

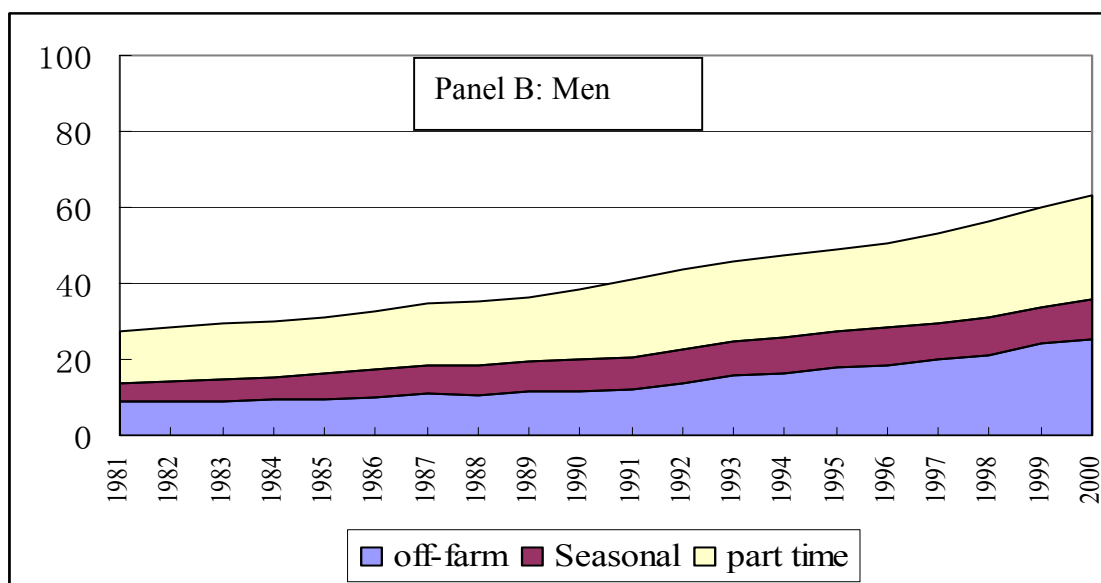
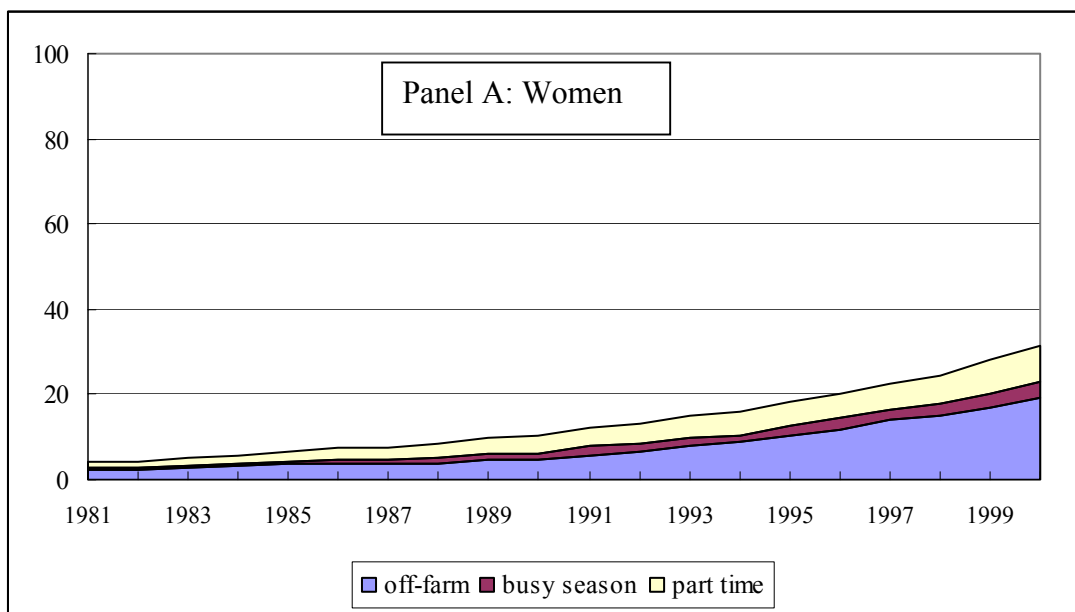


Figure 2. Increase in off-farm employment by Gender, 1981-2000
 Source: CNRS.

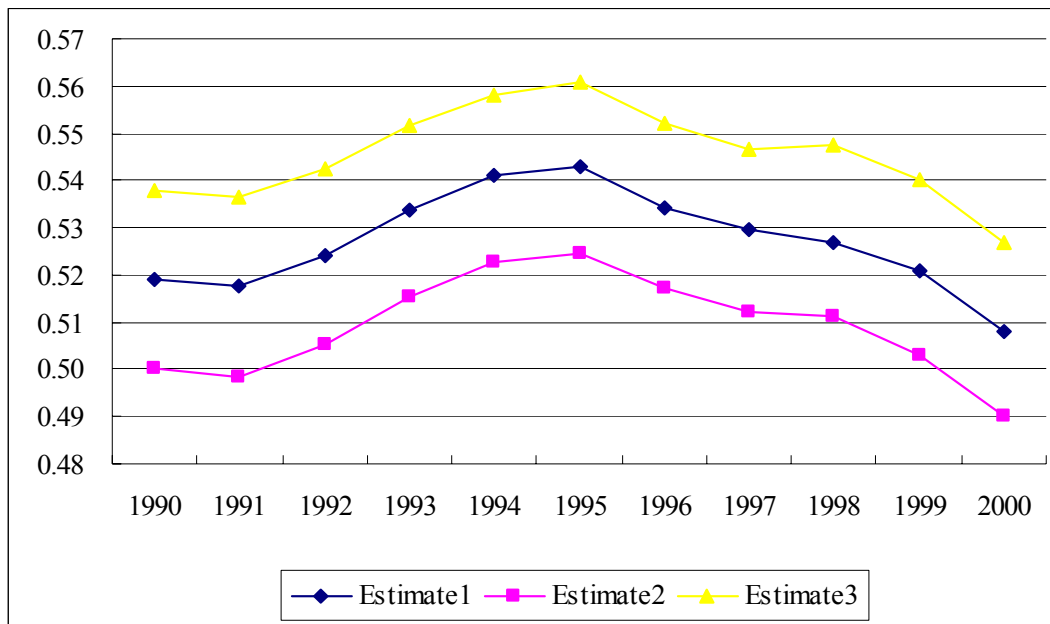


Figure 3. Estimated Proportion of Household Farm Labor Force that is Female, 1990 to 2000.
Source: CNRS.

Table 1. Labor Market Participation Rates for Men and Women in Rural China, 1981-2000

Employment	1981	1985	1990	1995	2000
			(percent)		
Total off-farm employment	16	18	23	32	48
Of which:					
Men	27	31	38	49	63
Women	4	7	10	18	31

Source: CNRS.

Table 2. Off-farm Labor Participation Rates by Gender for Selected Age Cohorts in Rural China, 1990 and 2000

Age cohorts	Off-farm labor participation rates (percent)					
	1990			2000		
	Total	Men	Women	Total	Men	Women
16-20	23.7	29.9	13.1	75.8	74.7	75.6
21-25	33.6	47.3	13.1	67.2	78.8	53.5
26-30	28.8	47.9	8.8	52.5	72.8	33.7
31-35	26.8	44.4	6.8	47.6	70.5	22.5
36-40	20.5	37.3	3.6	43.3	70.0	20.3
41-50	20.8	33.3	5.2	37.6	61.2	18.7

Source: CNRS.

Table 3. Participation in Farmwork by Men and Women, 1990-2000

	CHNS			CNRS
	1990	1992	1996	2000
Average Hours of Farmwork Done by Men	1528.73	1145.98	1021.3	963.17
Average Hours of Farmwork Done by Women	1542.17	1106.92	941.12	882
Average Household Hours	3045.86	2252.9	1938.51	1845.17

Table 4: Determinants of the Proportion of Farmwork Done by Women, 2000

Explanatory Variable	OLS (1)	Logistic (2)
Proportion of Labor, Female	0.69 (8.11)**	2.96 (6.10)**
<i>Household Characteristics</i>		
Female Head (1=yes)	0.073 (1.82)*	0.287 (1.69)*
Experience of Head	-0.002 -1.57	-0.007 (2.14)**
Log, Household Wealth	0.015 (1.84)*	0.066 (2.79)**
Responsibility Land (mu)	-0.002 (1.88)*	-0.009 -1.6
Mean education, household (years)	0.009 (2.10)**	0.038 (2.53)**
<i>Household Demographics</i>		
Number males, aged 16-25	0.048 (2.27)**	0.215 (2.53)**
Number females, aged 16-25	-0.054 (3.74)**	-0.235 (2.95)**
Number males, aged 26-35	0.014 -0.53	0.067 -0.57
Number females, aged 26-35	0.016 -0.61	0.051 -0.43
Number males, aged 36-45	0.038 (1.81)*	0.194 -1.52
Number females, aged 36-45	0.042 -1.4	0.147 -1.13
Number males, aged 46-55	-0.015 -0.63	-0.038 -0.34
Number females, aged 46-55	0.025 -0.95	0.083 -0.68
Number males, over 55	-0.001 -0.02	0.016 -0.15
Number females, over 55	-0.06 (3.11)**	-0.267 (2.83)**
<i>Summary Statistics</i>		
N	1131	1131
Adj. R ²	0.221	

Notes: t-ratios in parentheses; standard errors calculated correcting for 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 5. Farm Hours Worked and Percent of People Working on Farm, by demographic group, 2000

<i>Demographic Group</i>	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
<i>All Men</i>	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
<i>All women</i>	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 6. Farm Hours Worked by Level of Involvement in Farming, by Gender, 2000

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

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

Source: CNRS.

Table 7. Domestic Hours Worked by Age and gender, 2000 (Unit: Per Capital Hours)

Age	Busy season (hours/day)						Slack season(hours/day)					
	female		male		Total		Female		male		Total	
	mean	obs	mean	obs	mean	obs	mean	Obs	mean	obs	mean	obs
16-20	1.57	70	1.32	41	1.48	111	1.61	70	1.29	41	1.5	111
21-25	2.65	89	1.15	55	2.08	144	3.2	89	1.21	55	2.44	144
26-40	2.49	459	1.14	280	1.98	739	3.37	459	1.31	280	2.59	739
41-60	2.47	569	1.12	381	1.93	950	3.32	569	1.6	381	2.63	950
Over 61	2.54	131	1.68	116	2.14	247	2.68	131	2.03	116	2.38	247
Total	2.45	1,318	1.21	873	1.96	2,191	3.18	1,318	1.53	873	2.52	2,191

Source: CNRS.

Table 8. 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 9. Analysis of the Effect of Women-headed Households on the efficiency of Farming, All Crops (Using Regression Results with Village-level Fixed Effects)

	Dependent variables: ln (gross revenue of all crops)					
	(1)	(2)	(3)	(4)	(5)	(6)
Household characteristics						
Female-headed	0.028 (0.37)	0.117 (2.90)***	-0.016 (0.19)			
Proportion of hours worked on farm by female				0.032 (0.77)		
Proportion of female household labor					0.001 (2.44)**	
Proportion of female household agricultural labor						0.001 (1.22)
Asset value	0.000 (0.49)	-0.000 (0.42)	0.000 (0.63)	-0.000 (0.64)	-0.000 (0.42)	-0.000 (0.66)
Farm size	0.002 (0.97)	-0.001 (0.54)	0.002 (0.92)	-0.001 (0.58)	-0.001 (0.52)	-0.001 (0.57)
Household size	-0.026 (1.61)	0.012 (1.58)	-0.026 (1.64)	0.011 (1.33)	0.006 (0.78)	0.010 (1.26)
Household head characteristics						
Age	0.005 (2.26)**	0.001 (0.91)	0.005 (2.16)**	0.001 (0.82)	0.001 (1.00)	0.001 (0.89)
Education (years)	0.005 (0.59)	0.004 (1.18)	0.004 (0.52)	0.004 (1.06)	0.004 (1.19)	0.004 (1.11)
Education performance dummy, 1=good	0.095 (1.38)		0.109 (1.55)			
Education of household. Head's mother		0.003 (0.48)	-0.007 (0.49)	0.002 (0.35)	0.002 (0.36)	0.002 (0.35)
Plot characteristics						
Irrigated	0.282 (5.30)***	0.210 (7.75)***	0.285 (5.27)***	0.207 (7.64)***	0.208 (7.69)***	0.208 (7.66)***
High quality soil	0.230 (5.12)***	0.217 (8.86)***	0.238 (5.17)***	0.221 (9.04)***	0.217 (8.84)***	0.220 (9.00)***
Plain	0.193 (0.84)	0.152 (1.28)	0.173 (0.74)	0.153 (1.29)	0.153 (1.29)	0.157 (1.32)
Hill	0.039 (0.17)	0.099 (0.86)	0.008 (0.03)	0.101 (0.87)	0.097 (0.84)	0.103 (0.89)
Terraced	0.057 (0.24)	0.072 (0.59)	0.037 (0.16)	0.073 (0.60)	0.067 (0.55)	0.075 (0.61)
Distance from home	0.001 (0.06)	0.004 (0.37)	-0.000 (0.01)	0.004 (0.35)	0.002 (0.20)	0.004 (0.31)
Shock from weather, pests, etc.	-0.012 (9.93)***	-0.011 (17.20)***	-0.012 (9.82)***	-0.011 (17.21)***	-0.011 (17.11)***	-0.011 (17.21)***
Single season	0.567 (13.80)***	0.576 (26.37)***	0.571 (13.76)***	0.577 (26.36)***	0.576 (26.36)***	0.576 (26.35)***
Constant	5.192 (19.52)***	5.367 (39.59)***	5.210 (19.32)***	5.372 (38.93)***	5.328 (38.68)***	5.356 (38.65)***
Observations	1518	5220	1489	5216	5220	5216
Number of villages	60	60	60	60	60	60
R-squared	0.21	0.18	0.21	0.18	0.18	0.18

Notes: Absolute value of t statistics in parentheses. Estimates were corrected for clustering. *, **, and *** mean significant at 10%, 5%, and 1%, respectively. Source: CNRS.

